THE FOUNDRY

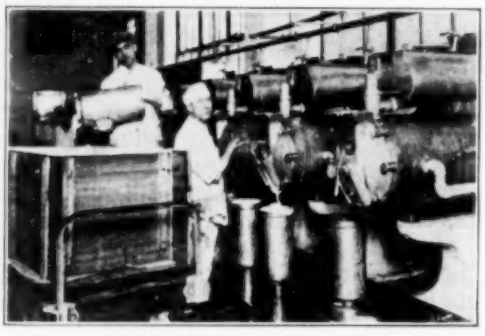
Volume 53
Number 15

CLEVELAND, OHIO, AUGUST 1, 1925

Published
Semimonthly

Cooling Dainties Made by Castings' Ready Aid

A GROWING taste for sweets on the part of old and young has antiquated the old laborious method of freezing ice creams, where Willie was delegated to turn the crank, and has created a market for this product of such proportions that its value is in the neighborhood of $250,000,000 per



Batteries of Machines Are Operated Almost Continuously in the Rush Season

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Find Where Castings Can Be Sold

CONTENTS

Still Waters Run Deep, But They Soon Become Stagnant 591

Three Level Handling Condenses Foundry Operations 593

Tip on Memory Contest 597

Survey Refractories in Malleable Industry 598

Should User Buy Castings By The Piece or By the Pound—By John C. Dinsmore 599

Makes Large Condenser Shell—By Harry A. Hart 601

Casts Large Exhaust Hood 605

Probe Aluminum Castings with the X-Ray—By Robert J. Anderson 606

Stop Foundry Accidents! — By Luther D. Burlingame 610

Refining Metals Electrically—By Larry J. Barton 612

Bill Hands Out Advice on Brake Shoes—By Pat Dwyer 615

Study Peeling in Malleables—By Douglas H. Ingall and H. Field 618

Patternmaker Should Study Joints — By Walter C. Ewalt 622

How and Why in Brass Founding—By Charles Vickers 609

Milestones in Foundry Progress 625

The Shakeout 626

Trade Outlook in the Foundry Industry 627

Comings and Goings of Foundrymen 628

Equipment Market Report 632

What the Foundries Are Doing 633

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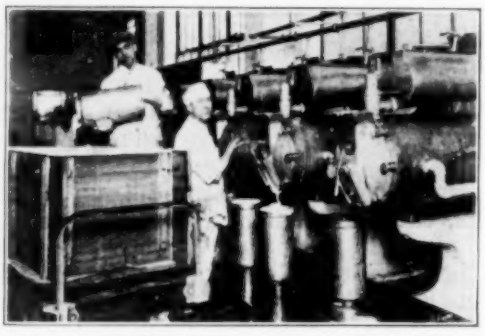

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Three Level Handling Condenses Foundry Operations

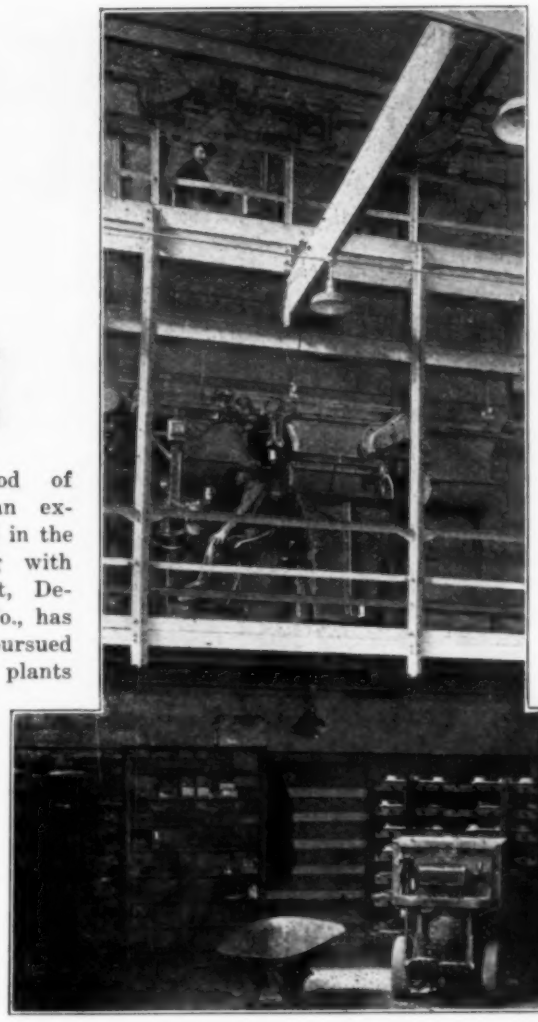


FIG. 1—IN THE CORE ROOM ONE SAND CONVEYING SYSTEM IS LOCATED ABOVE THE OTHER. THE UPPER CONVEYOR BRINGS THE SAND FROM THE MIXERS AND DEPOSITS IT IN FEED HOPPERS LOCATED NEAR ONE END OF THE BUILDING

EXTENDING over a period of many years, that is an extended period as reckoned in the automobile industry, beginning with the old Leland-Faulkner plant, Detroit, the Cadillac Motor Car Co., has expanded steadily and has pursued its activities in a series of plants scattered over a wide area. A few years ago when the number of individual plants had attained the respectable total of 77, the company decided on a policy of consolidation which resulted in the erection of a large, commodious, modernly equipped plant in the western part of Detroit. This plant with the exception of the foundries was established near Michigan avenue on a V-shaped tract of land between the tracks of the Michigan Central railroad and the tracks of the New York Central railroad. These tracks cross at a point west of the plant and an extensive area in the apex of the *V* was reserved for the foundry group. The foundries recently were completed and placed in production thus rounding out the plant and consolidating practically every phase of the automobile manufacturing process in one group of buildings.

The main plant was completed and occupied about two years ago, but for various reasons the erection, equipment and occupancy of the foundries was not consummated until February, this year. Castings requirements of the plant continued to be met satisfactorily by the former foundries of the company during the construction period of the new plant and latterly during the preliminary tuning up process which occupied about six weeks. The old foundry finally was abandoned and the new shops placed on a definite production basis about a month ago. However, the management anticipates a period, probably of several months duration, during which minor adjustments will have to be effected before the shops will function as sweetly and smoothly as the engines for which the company is noted. In this connection it may be interesting to observe that these same engines are subjected to a 6-hour continuous running test before they are mounted on the chassis. A tour of the entire plant, devoted to the production of 300 high class cars a day is highly instructive and interesting, but a description is entirely outside the province of this contemplated series of articles which will deal specifically with the foundry plant where aluminum, brass and iron castings are made in a highly modern manner to meet the rigid specifications of one of America's quality automobiles.

While the foundries still were in contemplation, H. B. Swan, foundry superintendent for the Cadillac company, visited practically all the prominent foundries engaged in the production of castings for the automobile industry and in this manner secured a first hand knowledge of their equipment and method of operation. This mass of information was absorbed and digested and afterward the salient features were incorporated and adapted to meet the particular requirements of the Cadillac company, in reference to plant limitation area and contemplated output.

Mr. Swan was particularly well qualified for this work. He grew up with the company and therefore, is acquainted intimately with every phase of the problem involved in the production of its castings. Shortly after his graduation in 1909 from the University of Michigan with the degree of chemical engineer he accepted a position first as coremaker and later as metallurgist in the old Cadillac foundry at that time presided over by the veteran J. J. Wilson. In a short time he was promoted to the position of assistant superintendent. When Mr. Wilson in 1918 was transfered by the General Motors Corp., of which the Cadillac Co. is a subsidiary, to supervise the construction of its Saginaw, Mich., plant, and which by the way he managed for several years afterward, Mr. Swan was advanced to the position Mr. Wilson vacated.

In connection with his routine duties he has carried on extensive research work in metals and their alloys and has contributed several papers to the technical press and to the *Transactions* of the American Foundrymen's association. He was vice president of this association in 1915-16 and in 1924 again was nominated and elected vice president but was obliged to decline through private reasons.

He is greatly interested in the progress of the foundry industry and is convinced that it offers a wide and fertile field for cultivation by the engineering profession. Confirming his theory he has persuaded several recent

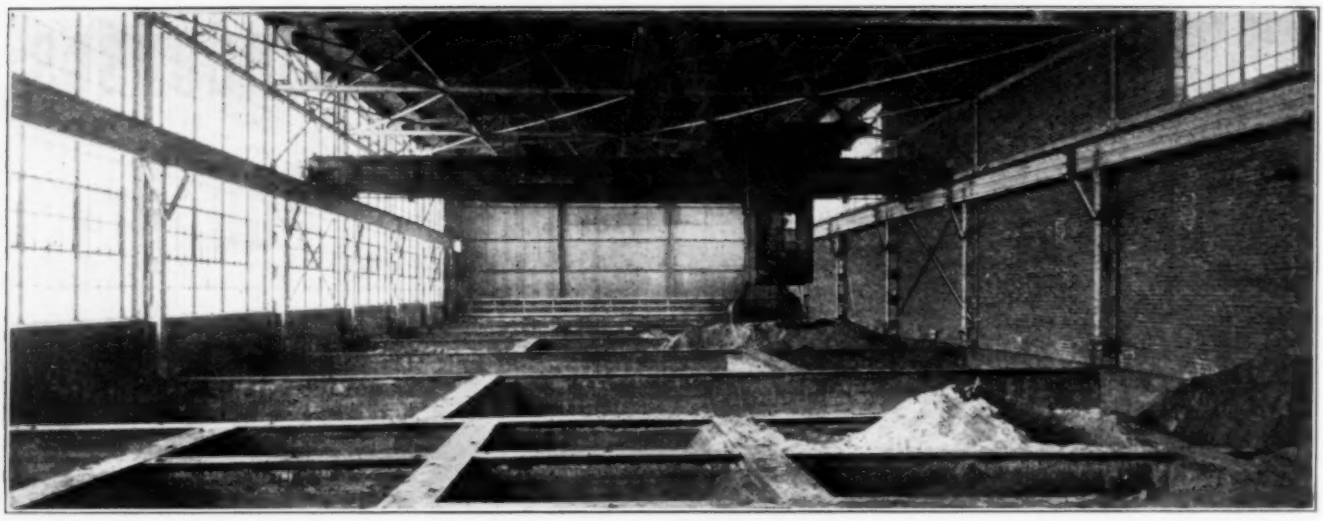


FIG. 2—SAND IS HANDLED WITH A CRANE EQUIPPED WITH A GRAB BUCKET AND IS STORED IN A SERIES OF CONCRETE BINS WITH A TOTAL CAPACITY OF 8000 TONS

graduate engineers from the University of Michigan to take service with him as special apprentices. These young men in overalls are given intensive instruction in actual production work and are moved from time to time through the various departments and ultimately will be advanced to executive positions.

Intimate personal contact with actual details of operation backed by their engineering training which fosters and promotes the faculties of observation, calculation and analysis will produce men, it is confidently anticipated, particularly well qualified to superivse the production of castings under modern conditions.

To a certain extent the scheme may be regarded as selfish in that it undoubtedly will result in the building up of a strong organization, but it also is altruistic to the extent that the young men are not bound by any agreement, no strings are attached to the offer when they accept employment and they are free to seek employment elsewhere when they feel like making a change or when opportunity presents itself. They are paid the current rate

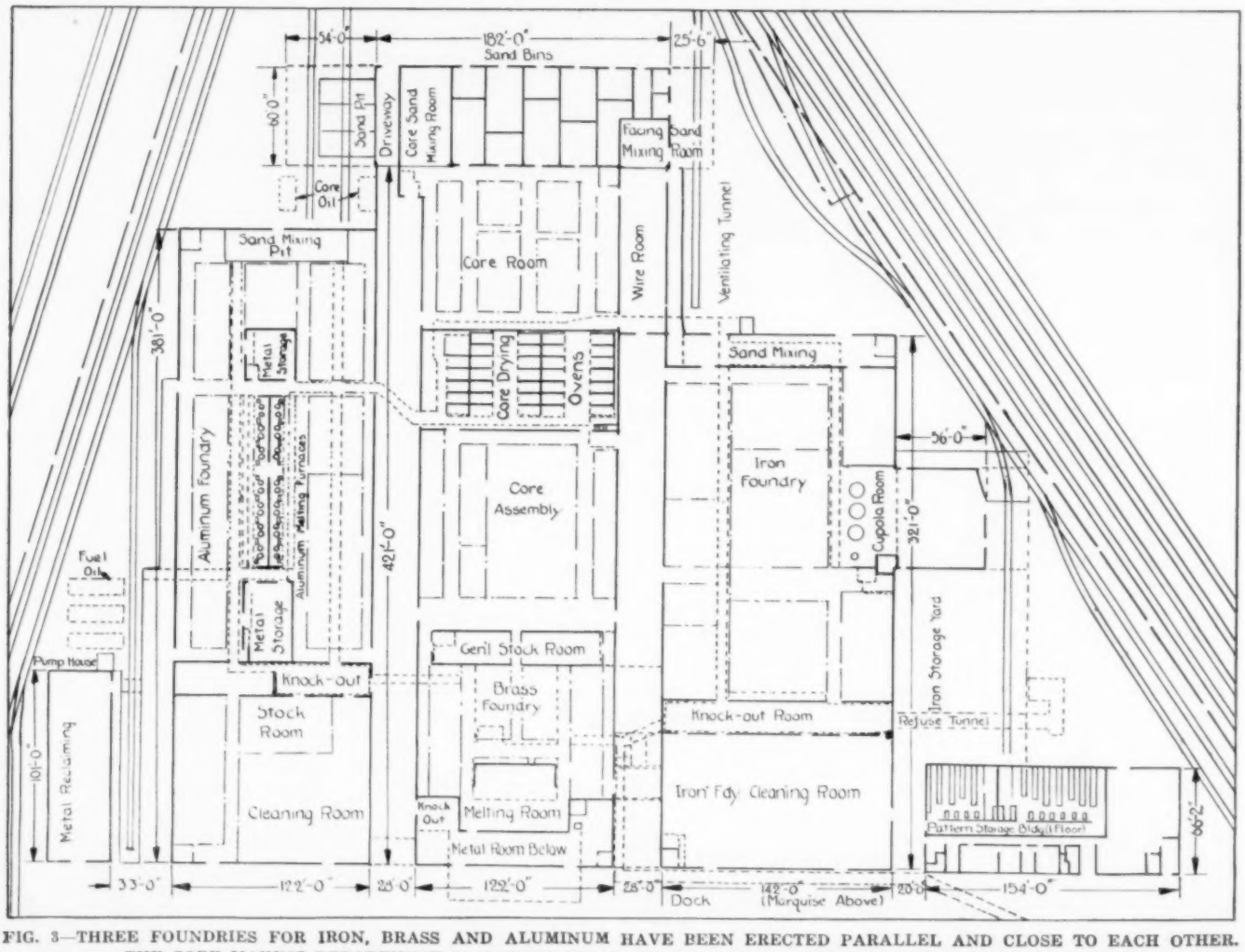


FIG. 3—THREE FOUNDRIES FOR IRON, BRASS AND ALUMINUM HAVE BEEN ERECTED PARALLEL AND CLOSE TO EACH OTHER. THE CORE MAKING DEPARTMENT IS HOUSED IN A CONTINUATION OF THE BRASS FOUNDRY BUILDING

of wages for the work in which they are engaged and the other features are placed at their disposal gratis.

Gradual evolution in the foundry industry, evolution in great measure traceable to the introduction of mechanical equipment has reached a point where it is practically hopeless to develop supervisory talent from the ordinary rank and file. This feature naturally is more apparent in foundries where intensive production methods are practiced on repetition castings. Methods are standardized to a point where the individual workman is only one of the many and relatively unimportant cogs in the industrial machine. He has neither the inclination nor the opportunity to become familiar with the functions of other cogs either individually or collectively. In strict justice, also, it must be admitted that the class from which the ordinary foundry labor is recruited has not the mental capacity for supervision. To what extent this condition is due to lack of familiarity with the English language is problematical. However, in the meantime conditions are conditions and any speculation on what may obtain with a second or third English speaking generation, is idle and beside the mark.

The foregoing is somewhat of a digression, but it is pertinent in that manual labor and intelligent supervision are just as necessary as mechanical equipment in the operation of a foundry. Some day it is possible perfect castings may be produced automatically by a machine, but according to all present indications that time is in the indefinite future. In the meantime labor, supervision and equipment are three essential factors that must be considered.

Many features of the new foundry are exact duplicates of those in use elsewhere, others are a compromise between two or more and several are distinctly original and peculiar to the new plant itself. The Austin Co., Cleveland designed and supervised the erection of the plant and its engineering staff drew freely on a fund of knowledge accumulated over a period of many years in the industrial construction field. A study of the floor plan of the foundries shown in Fig. 3 will assist materially in visualizing the location of the different departments in relation to each other, the position of various pieces of equipment, the area devoted to each unit and a general idea of the appearance of the group of foundries as a whole.

All the buildings terminate in a common straight line at what may be termed the base of a triangle in which the two railroad tracks previously mentioned form the two sides. The other walls of the buildings are built in a series of jogs designed to fill the available space to the best advantage and still remain at right angles to the base. The rectangular form of construction was favored over one that possibly might have followed more closely the shape of the property, because the rectangular shape permitted the use of all standardized steel shapes and obviated the necessity of special cutting and fitting to shape.

With the large area of land at its disposal the company did not feel any necessity of cramping itself. The shops have a capacity approximately 50 per cent in excess of present requirements, and it is anticipated that they will serve adequately for many years. In a few instances the complete equipment is not installed, but foundations are down and other necessary features provided in the floors, walls and roofs. When the proper time arrives the additional equipment will be dropped into place easily, quietly and without interfering with routine operation.

Long forgotten evidence of the days when Detroit was a great sawmill town and the outlet for all the lumber from the lower peninsula of Michigan, was disclosed when the construction gang put down the excavations for the tunnels and foundations under the walls and columns. The plant is built on the old site occupied for many years by the American Car & Foundry Co., and the engineers naturally expected to dig through a stratum made up of a mixture of burned sand, slag, coke, core butts and pieces of scrap representing the usual foundry dump.

They were not disappointed. The surprise came when the diggers penetrated the dump and found themselves wallowing in a bed of sawdust. In some places the excavations had to be carried to a depth of 15 feet to reach the original earth surface on which for a period of many years some

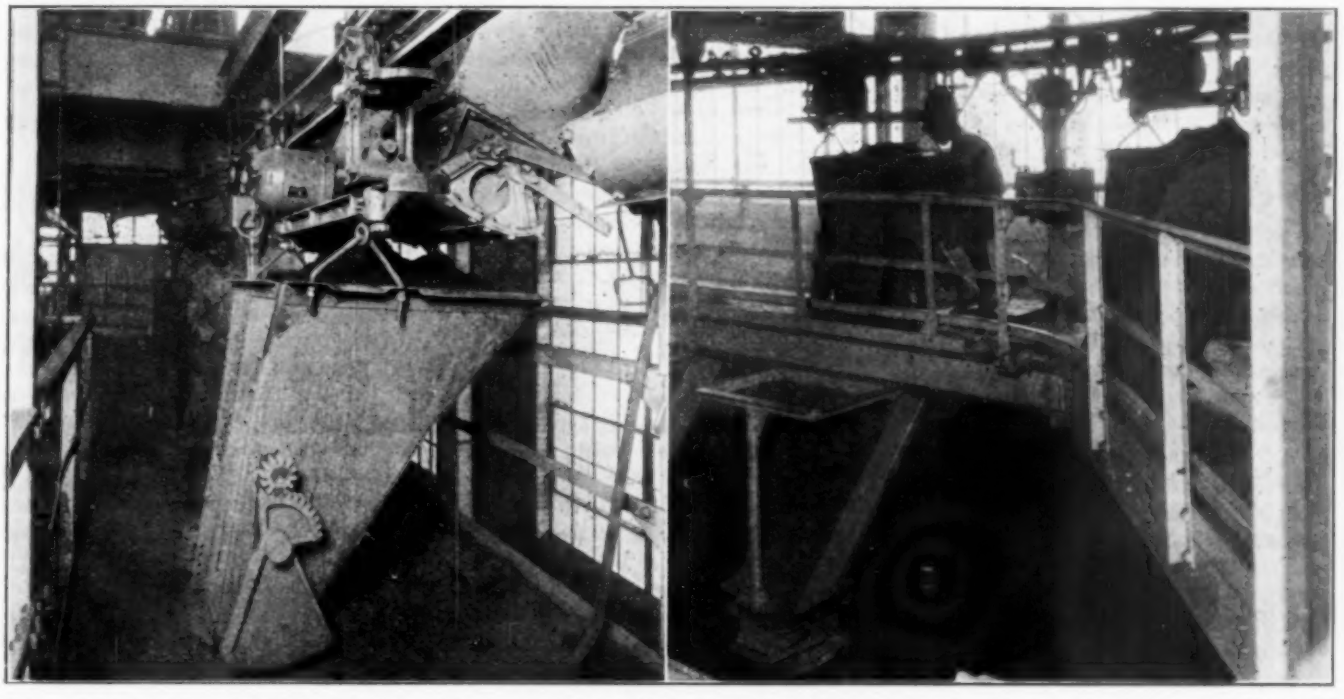


FIG. 4—DETAIL OF TRAVELING HOPPER. FIG. 5—THE OPERATOR TRAVELS WITH THE SAND BUCKET AND FILLS THE VARIOUS FEED HOPPERS LOCATED AT THE MOLDING STATIONS

dead and forgotten mill man had piled a mound of sawdust ripped by the screaming saws from the white pine logs of Michigan.

Partly through necessity a condition brought about by a scarcity of suitable labor and the high wage rate prevailing among the available supply, and partly through a commendable desire to standardize as far as possible all manufacturing methods, mechanical equipment has been installed in the foundry on an extensive scale. As an instance of the extent to which one time laborious hand methods have been displaced, the core sand is not touched by hand or by a hand wielded tool from the time it arrives in the railroad car until it is delivered on to the coremaker's bench or into his corebox.

In some respects the foundry may be classed as a three-story building. It possesses practically all the advantages of a building of that type without the added cost of the extra stories. A series of connected tunnels under the floor furnish approximately the same convenience that might be expected from a full basement. Sand is distributed through a comprehensive overhead system which confers a benefit comparable to that which might be derived from a full upper floor.

To sum the situation briefly, the main floor is used for making and pouring the molds, sand is shaken out and returned to common rejuvenating stations through tunnels under the floor, carriers suspended from monorail hoists take the sand from the overhead storage tanks and distributes it to the chutes that serve the various molding stations.

Use Oil Burners

Other interesting features in which mechanical equipment plays an important part and reduces the number of men required, include the method for firing the ovens and for pouring the metal. The ovens and also the furnaces in the aluminum foundry are heated by oil pumped from a central source of supply in three large tanks located under ground near the railroad tracks on the south side of the aluminum foundry and having a combined capacity of 60,000 gallons. The pump house also is underground and connects directly with the series of tunnels under the foundry in which the supply pipes are carried.

Methods of pouring the metal vary according to whether it is iron, brass or aluminum. Also, the methods vary to some extent depending on the character of the castings produced on different parts of the floor in any one of the three shops. The most elaborate system is in the iron foundry where the metal is taken from the cupolas in 1000-pound ladles suspended from electrically controlled hoists operating on a monorail track that serves the entire floor area. One man operates each of these hoists and pours all the molds in any given area. Detail of equipment and pouring methods will be taken up in subsequent issues of THE FOUNDRY dealing with each one of the three foundries as a unit.

Distribute Sand Mechanically

Reference to the plan shown in Fig. 3 will show how the sequence of operation begins at the sand supply bins at the extreme west end of the buildings and progresses steadily toward the shipping dock which extends all the way across the east end of the entire group of buildings. In all, capacity is provided in the sand storage building 60 x 182 feet for 8000 tons of sand. The building is served by a 5-ton crane made by the Cleveland Crane & Engineering Co., Cleveland. Incoming sand is distributed according to its character to various bins by a grab bucket suspended from the crane.

These storage bins extend upward from the floor 15 feet. Each one is provided with a doorway leading to the foundry adjoining, through which sand may be procured if necessary. However, in ordinary routine the sand is lifted from the bin by the same bucket which placed it there and dropped into any one of four elevated bins over the core sand mixing room or of two bins over the facing sand mixing room. These bins are provided with chutes in the bottom through which the sand flows by gravity into measuring devices that feed the mixers erected on the ground floor. Core sand is prepared in two machines made by the Standard Sand & Machine Co., Cleveland. Foundations and other preparatory features are ready for two additional machines when the volume of operations warrant their installation. The same condition prevails at the facing sand end. At present all the facing is prepared in a 6-foot pan type machine made by the National Engineering Works, Chicago. Sand bin, chute and foundations are available whenever a second machine is considered necessary.

Since the iron foundry and the aluminum foundry are the largest of the group they were placed on the outside with the brass foundry in the center. They are separated from each other by courts 28 feet wide. The extreme northeastern corner of the plot of land is occupied by a five-story building 66 x 154 feet in which the general foundry office, and the locker and wash rooms are located on the ground floor. Patterns are stored on the second and third floors. The fourth floor is devoted to making patterns in both wood and metal. An extensive and well equipped laboratory is maintained on the fifth floor.

The ground area to the west of this building is utilized as an iron stockyard and is served by a 5-ton crane with an 80-foot span supplied by Manning, Maxwell & Moore, New York. The crane runway extends over an outdoor extension to the charging deck behind the cupolas and this extension in turn serves for a roof to the room behind the cupolas where ladles are daubed and dried and where miscellaneous cupola repair materials are kept.

A spur from the New York Central railroad serves the stockyard. Iron, coke and limestone are brought in and empty cars are loaded with old sand and other refuse by a bucket elevator. This material is brought to the foot of the elevator by a belt running in a tunnel under the yard to a point in the knockout room in the iron foundry where all this material is dumped through a suitable grating in the floor.

Both hot air and steam are utilized for heating the buildings. Steam radiators are erected close to the walls at the floor level and hot air is distributed through a series of pipes that extend to all parts of the buildings. The air is heated by first driving it through a series of steam heated coils. By cooling these pipes in the summer the same blowing apparatus and system of pipes will deliver cool air to the workmen.

Building Construction

Ventilation is secured through swinging side windows in the walls and in the inverted single and double V-shaped roofs that cover the various buildings. The melting chambers in the aluminum and brass shops are partly partitioned off from the molding areas and in addition are covered by extensive hoods which collect and dispose of practically all the smoke.

The various buildings are of combined brick, steel and concrete construction. The roofs are nearly all glass and in the walls the windows extend from the eaves to within a few feet of the ground. Floors of all departments with the exception of the coreroom are laid in brick roughly surfaced with cement. In the core de-

You Are Presented With a Hot Tip on the Memory Contest

LOOK closely at the portrait which is reproduced at the left. Recognize the gentlemen? This is J. S. McCormick, foundry supply and equipment manufacturer, Pittsburgh. This photograph was made in Atlantic City, during the 1915 *American Foundrymen's association convention. Mr McCormick, who in* 1908 *was treasurer of the Foundry machine & Exhibition company which managed the exhibits at the American Foundrymen's association convention in Toronto, is a prominent figure in the contest picture which appeared on page* 564 *of the issue of July* 15, 1925. *See if you can identify him.*

Other recent photographs of those in the contest picture will be presented as received. Don't be discouraged if you can name only a few. C. E. Hoyt, secretary of the American Foundrymen's association could name but eight at first inspection.

THE CONTEST PHOTOGRAPHY AND TERMS WILL BE REPRINTED IN THE ADVERTISING SECTION OF THE PRE-CONVENTION, OCT. 1 ISSUE, OF THE FOUNDRY.

partment the cement covering is slicked smooth and level to facilitate the movement of the trucks that convey the core racks into and out of the ovens. Detailed description of the manner in which the foundries are equipped and operated will appear in early issues of THE FOUNDRY.

Graphite Spoils Casting

Question: We are frequently troubled with excessive free carbon in the form of graphite on the first tap from the cupola, slightly on the second tap but not thereafter during the heat. The analysis of the charge put in the cupola is as follows:

	Per Cent
Silicon	2.75-3.00
Sulphur	0.04-0.06
Phosphorus	0.40-0.60
Manganese	0.50-0.70

The charge consists of 40 per cent Northern pig iron, 5 per cent steel sprues, 25 per cent shop scrap and 30 per cent A1 bought scrap.

Sometimes the castings show this graphitic carbon on the surface in such quantities that the castings must be scrapped.

The castings are soft as we desire speed in cutting and we are sacrificing the strength for softness.

We would like to know the cause and the cure.

Answer: Graphite forms as flakes or planes of cleavage in the iron itself and seldom, if ever, appears on the surface of castings. When it does appear on the surface it is found only in open cast work. Hence, the cause of the defective castings cannot be blamed on graphitic carbon.

From the data given we believe that the defects in the castings are caused by the blacking being washed from the face of the mold, by the iron being too hot. This conclusion is based on the fact that the defects are noted only on the first tap and part of the second. The openness of the charge in the early stages of melting, tends toward rapid and hotter melting conditions.

There is also the possibility of the blacking being too thickly applied on some portions of the mold and invariably, if this is the case, the blacking will wash before the molten iron. Therefore, we suggest that you examine the castings carefully and determine whether the defects are caused by graphite from the blacking used and not from the iron. The quality of the blacking frequently is responsible for trouble.

Reports on Accidents

The combined accident experience of 163 members of the Metals section of the National Safety council shows a decided improvement in 1924 over 1923. The average severity rate of 2.080 still is larger than the severity rate for 1922, which is 1.557, but the largest accident tabulation that the council has ever made is creditable to the section. The reduction for the section as a whole was accomplished by reason of the fact that members operating steel plants, blast furnaces, and rolling mills, were composed of large employers and that group cut their average severity rate for 1924 almost to half of the 1923 rate. Six members of the section finished the year 1924 without a lost time accident.

The ownership of the Waterbury Castings Co., Waterbury, Conn., has passed to the control of the J. L. Mott Works, Trenton, N. J., and the Albany Malleable Iron Co., Vorheesville, N. Y. The purchase price is given as $150,000.

Milwaukee Foundry Equipment Co., manufacturers of molding machinery has occupied new quarters at 284 Seventh avenue, Milwaukee.

Survey Refractories in Malleable Industry

REFRACTORY materials for various industries have been studied by committee C-8, of the American Society for Testing Materials, the latest industry to receive the benefits of these investigations being the malleable iron industry. The accompanying article was taken from a report submitted and discussed at the Pittsburgh meeting of the committee. Tentative classifications have been assigned to the refractories used in the different parts of the furnace, which later may be used in the preparation of specifications for this material.

MALLEABLE iron in this country, refers to a ferrous product cast from a metal prepared by melting and refining to a desired analysis, a mixture of pig iron, steel and malleable foundry remelt. The mixing and subsequent refining process must be carried to a point that will insure the proper percentage of carbon, silicon, sulphur, manganese and phosphorus in the finished bath.

Structure of the product as cast must be such that all of the carbon is combined with the iron to form carbide of iron. The cast product is subjected to a heat treating process, whereby the chemical union between the carbon and the iron that exists in the product as cast, is broken down. Nodules of free carbon are released from their union with the iron, during the heat treating process, carbon gathering in the irregular dots and is known as temper carbon. The product, after passing through the heat treating process, is ductile and malleable and develops a tensile strength of 50,000 pounds or more per square inch and an elongation in 2 inches of 10 per cent or more.

The metal for casting may be prepared in a reverberatory air furnace, open-hearth furnace or cupola. The reverberatory air furnace, which is most extensively used in this country, consists of a firebox, a hearth, separated from the firebox by a bridge wall, a rear bridge wall and two side walls. The roof of the furnace consists of removable bungs or arches, made up by properly fitted refractory shapes, held in metal frames. The reverberatory air furnace in use in this country averages about 6 feet in width and 18 to 20 feet in length of hearth. The capacity varies from 5 to 40 tons per charge with an average of around 15 tons per charge.

The furnace is charged through openings in the roof, some of the bungs being removed for this purpose, although in a few cases, charging is done through doors in the side walls, the bungs in such cases not being lifted or disturbed. Heat is generated in the furnace by the combustion of coal, oil or gas. Coal is the fuel most commonly used. High temperatures and rapid heating are possible with powdered coal and this method of heating is rapidly coming into favor. The most common method of firing is that of burning bituminous coal on a grate under forced draft. Refining takes place during the last 2 to 2½ hours of the heat. Manganese, silicon, and carbon may be removed, first together with iron oxide, forming a slag which readily attacks the side wall bricks along the line corresponding to the top of the bath. A typical air-furnace slag analysis according to H. A. Schwartz in his publication entitled American Malleable Cast Iron is as follows:

	Per Cent
FeO	28.80
Fe_2O_3	1.16
MnO	4.85
SiO_2 (etc.)	50.42
Al_2O_3	14.77

The slag is skimmed off the top of the bath, either once or twice dur-

(*Concluded on Page* 600)

Table I

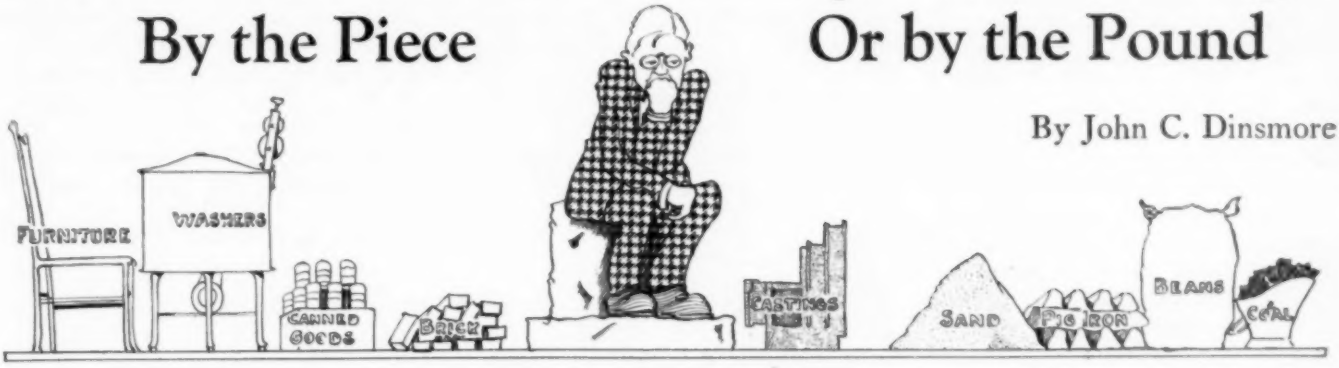
Classification of Refractories for Melting Malleable Iron

	Part	Material Used	Temperature	Spalling	Slagging	Load	Abrasion	Tentative Classification	Remarks
Air Furnace	Bungs	Fire clay	Up to 1650°C. (3000°F.) near front bridgewall, up to 1370°C. (2500°F.) near center of furnace, up to 1315°C. (2400°F.) at neck	Very important for charging bungs, important to moderate for others	Not of great importance	See note under "Remarks"	Of some importance near front and back bridgewall	H-19	The brick in the bungs are subjected to pressure which may be as high as 1000 lb. per sq. in. due to setting up the clamps too tightly. This would be increased considerably due to thermal expansion when the bungs were heated up.
	Side walls	Fire clay	Varying from 1650° C. (3000° F.) at top of sidewall near the front bridgewall to 1315°C. (2400°F.) near the back bridgewall	Important above the slag line	Important from the hearth up to the lag lines	Maximum of 10 lb. per sq. in.	Unimportant	H-55	
	Fire box	Fire clay	1370°C. (2500°F.) max.	Moderate	Important	Maximum of 10 lb. per sq. in.	Unimportant	H-64	
	Stack lining	Fire clay	1315°C. (2400°F.) max.	Unimportant	Unimportant	Depends upon construction, 50 lb. per sq. in. max. Usually an inner lining is built to a height of 15-20 ft. The load here is not in excess of 15 lb. per sq. in.	Unimportant	H-1	
	Brdg.-walls	Fire clay	1480°C. (2700°F.) max.	Moderate	Important	Unimportant		H-64	
Annealing Ovens	The temperature in the ovens is not over 1700° F., except in the fire boxes, where 2100° F. is the maximum obtained. The load is not in excess of 15 lb. per sq. in., so that the refractory requirements are not at all severe.							M-1	

Should User Buy Castings

By the Piece Or by the Pound

By John C. Dinsmore



LET'S look at the article which appeared in the March 1 issue of THE FOUNDRY, entitled Who Is to Blame for the Purchasing Agents' Slant on Buying Castings. The author of this article says that "While foundrymen generally are willing to ascribe many of their trials and troubles to the purchasing agent, the majority are fair minded and are willing to recognize their own shortcomings. Purchasing agents may be steeped in profound ignorance and insist upon buying castings on a pound basis." The implication in the first part of the statement is that the vendor of castings finds that he is no match for the purchasing agent in making a deal. A Victim seeks to convey the impression that the purchasing agent who seeks to purchase castings on a strictly pound basis is ignorant, wasteful and unfair to the vendor. A little further on the same author points out the dire results which may follow if he buys them on the basis of so much each. If castings may not be purchased safely on either a pound basis or on the basis of so much each, how may they be purchased.

A Victim rails at the foundrymen who cut unit prices to build up volume of business and so reduce overhead. These foundrymen do so he claims because they are not willing to accept a dare from their price competitors.

If the mere intimation that others are cutting prices—when they really are cutting prices—will cause the average foundryman to lower his bid, the purchasing agent who pays the asking price for castings is throwing his firm's money away. Remember that the chap who spends his firm's money must be sure that the price he pays is in line with the prices others are paying for similar commodities—are in line with production costs and that these production costs are as low as they should be.

TRADE practices do not result from the impulsive action of one seller and one buyer, but are the cumulative result of many transactions. Thus a newcomer into either the producing or using end of the castings manufacturing industry cannot but be surprised at some of the existing procedure. In an article which was published in the July 15 *issue of the* THE FOUNDRY, *Mr. Dinsmore discussed some of the points raised in the issue of Feb.* 15 *by a foundryman writing under the pen name of A. Victim. In the accompanying article, the second of A. Victim series is taken apart under the searching light of a purchasing agent's experience. The existing practice of selling castings as bulk commodities, that is by the pound, instead of regarding them as finished articles of manufacture to be sold by the piece, seems to be puzzling.*

THE EDITORS.

A Victim says the purchasing agent may prefer to remain in ignorance of the true reason for low costs. This does not at all check with my knowledge of the purchasing agent. Most emphatically he wants to know all about the materials he buys all the time if that were possible.

A Victim charges that the purchasing agent not only uses unfair methods in securing lower prices on his castings, but that he promptly brandishes these ill gotten concessions in the face of all the foundries in the neighborhood who seek to secure a share of his business, and that he continues to wave these prices under the eyes of the foundrymen long after the market has stiffened. No doubt nearly every young purchasing agent has been guilty of some such action once. The direct results of this sort of action are so immediate and so painful that the performance is not repeated by even the most stupid purchasing agent. One's prices are confidential and the purchasing agent knows that he is digging his own commercial grave when he fails to keep prices to himself.

A Victim berates the purchasing agent who indulges in sharp practice, and rightly, but he seems to think it quite all right for the foundryman to "slip under the purchasing agent's guard and nick him cruelly." It seems to me that sharp practice is to be condemned equally whether indulged in by buyer or seller.

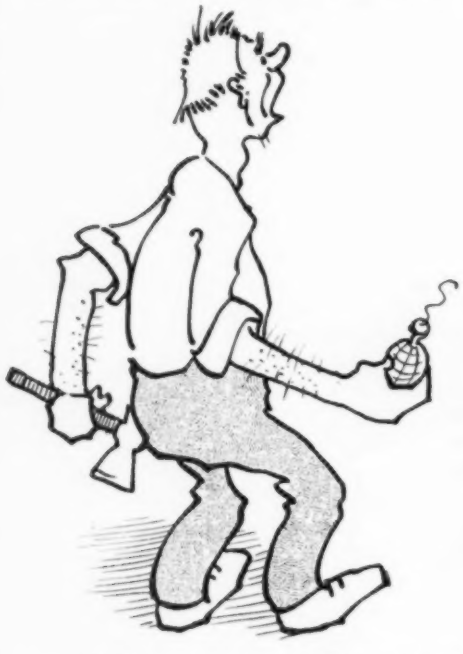
A Victim complains that many purchasing agents cause the foundrymen to lose their fair profits by changing sources of supply just when the foundry gets all set to make some money on the account. This is one of the situations that all vendors must face. If their margins are reasonably low they should not be afraid to tell the purchasing agent what they are and depend upon him to protect the vendor's interest. If these margins are so wide that the foundryman would not be willing to tell the purchasing agent about them, he can hardly expect to have these too wide margins protected.

In every line of business there is a growing tendency toward the frank discussion of costs, overhead and profit margins between seller and purchasing agent. Where this relationship of mutual confidence and respect exists there is every reason for the purchasing agent to help the vendor protect his margins of profit provided

only that these margins are modest and the operation is relatively efficient.

A Victim cites the instance where the price on certain structural cast-iron columns was forced down so low that the foundryman had to cheat on the quantity of metal to make a profit. As a result a mill floor collapsed. His inference is that the purchasing agent was at fault. How about the foundryman? It is true that the purchasing firms inspection department should have caught the skimped column, but the vendor was guilty of securing money under false pretenses—guilty of risking the life and limb of the innocent mill employes to make a larger margin of profit. The foundryman who sells his product in a highly competitive market and is so inefficient as to be unable to make a fair profit without skimping the job is not a business man—*he is a joke.* Competition is responsible for lowered unit costs and so is indirectly responsible for more efficient production methods. Without the presence of competition we all would be at least a generation behind in our standards of living.

A Victim condemns—and justly—the practice of rushing orders through and then letting the material remain



unused for many days. This sort of thing should not happen but does happen in nearly every organization, sometimes. However, this usually is due to a last minute change in production schedules or a breakdown somewhere. Who would be foolish enough to want to tie up money in materials long ahead of the time when they would be needed.

To the unbiased reader it would appear that the chief difficulties encountered by A Victim in selling castings to purchasing agents lies in his own ignorance, lack of cost and competition data and his own prejudice against "the whole tribe of purchasing agents." What he needs apparently is more accurate knowledge concerning his own product, his own costs and a course in the psychology of selling. First of all he must be

"ONE'S prices are confidential and the purchasing agent knows that he is digging his own commercial grave when he fails to keep prices to himself."

sincere and possess a genuine desire to serve this customer, the purchasing agent. Next, he must convince the purchasing agent of his knowledge and his sincerity and desire to serve. For the vendor to try to sell any product to a man whom he dislikes and whose firm he fears is to prepare for failure.

Survey Refractories in Malleable Industry

(*Concluded from Page* 599)

ing the heat. Unless considerable care is exercised during the latter part of the heat, an appreciable quantity of iron will be oxidized, which not only is detrimental to the balance of the metal, but is active in destroying the refractories used in the furnace construction.

The castings when cold, are cleaned, surrounded with packing in iron boxes and submitted to the heat treatment referred to in the first paragraph. The heat treating process is carried out in an oven lined with fire brick and heated from one end by a firebox in which coal commonly is burned. It might be said that some of these ovens in use in the malleable iron industry, are heated by powdered coal and oil. The maximum temperature used for heat treating is in the neighborhood of 900 degrees Cent. The annealing cycle requires on the average of from seven to eight days for completion.

Book Review

A Course of Metallurgy for Engineers, by F. C. Thompson, B. Sc., D. Met., 240 pages, cloth, 5½ x 8½ inches, published by H. F. & G. Witherby, London and furnished by THE FOUNDRY, Cleveland for $5.00 net.

An engineer understands little about the structure and the nature of the metals and alloys that he uses in his profession, and this book will give him a good conception of the subject. The beginner in metallurgy may use the book to his advantage.

Steel is the most used alloy in engineering, and the topic is ably discussed in the various phases of composition, heat treatment, hot and cold working and case hardening. Cast

iron, brass, bronze, aluminum alloys and bearing metals are covered and the mechanical treatment and properties of these alloys and metals discussed.

The microstructure of the metals and alloys is considered carefully and illustrated by many photomicrographs.

Makes Large Condenser Shell

Equipment Carefully Prepared in the Pattern Shop Greatly Facilitated the Construction of a Type of Mold That Presents Many Features Out of the Ordinary

By

Harry A. Hart

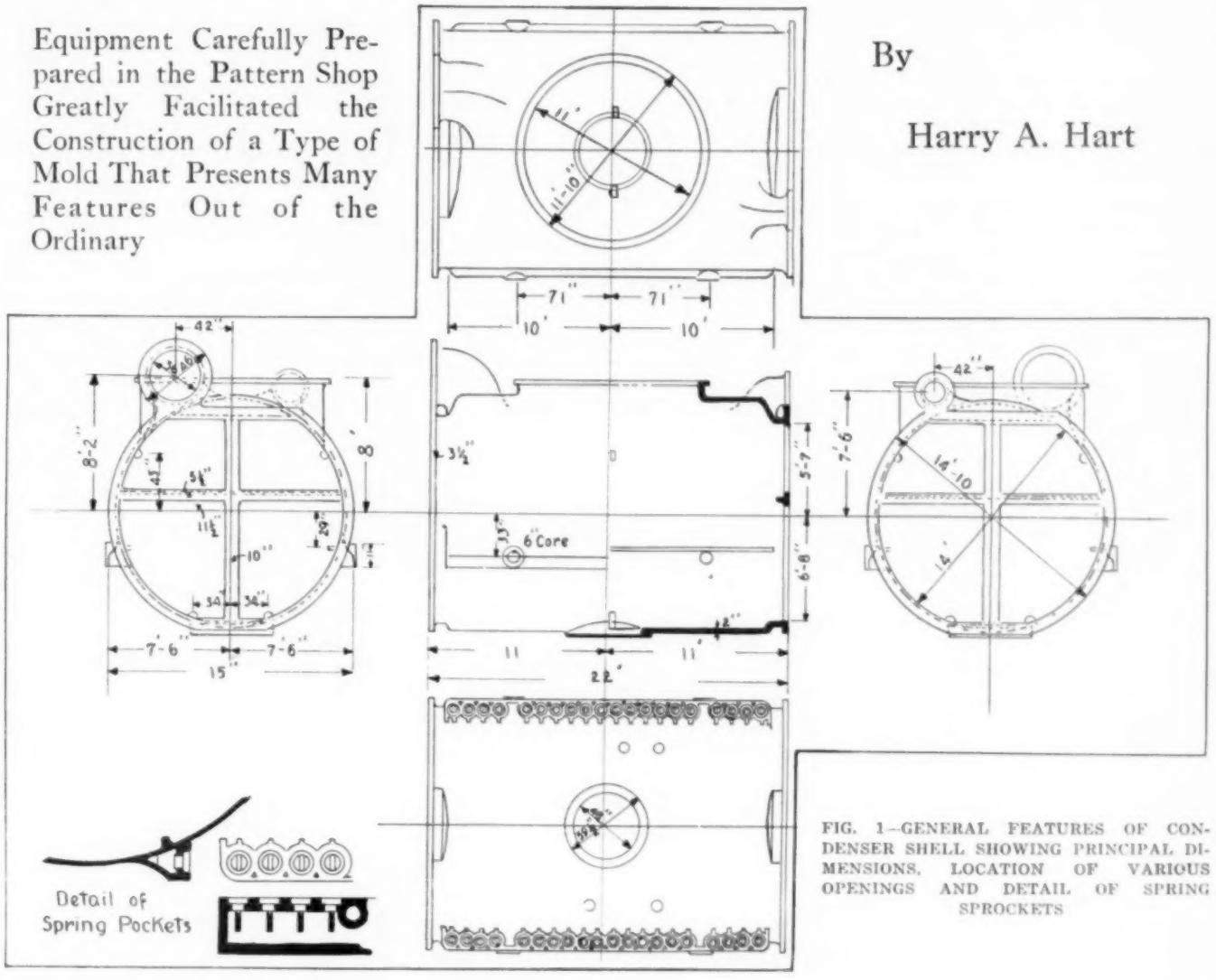


FIG. 1—GENERAL FEATURES OF CONDENSER SHELL SHOWING PRINCIPAL DIMENSIONS, LOCATION OF VARIOUS OPENINGS AND DETAIL OF SPRING SPROCKETS

ONE department of the extensive River Rouge plant of the Ford Co., that has received practically no published recognition is the jobbing foundry. Other departments including the production foundry where the castings for 2,000,000 automobiles are turned out yearly have furnished copy on many occasions to both the newspapers and the technical press. With few exceptions the descriptions appearing in one medium have been as inaccurate as they have been in the other. Methods pursued in the jobbing foundry usually present no spectacular features even though operations are carried on a scale only equaled by a comparatively small number of foundries in this country. This foundry which makes nothing but repair castings for existing equipment and part of the tonnage of new castings required for the constantly expanding plant installation employs between 500 and 600 men and pours iron castings to the extent of 100 tons per day.

Recently the foundry has been engaged in the production of eight sets of castings for specially designed steam turbo generators for the main power house at the River Rouge plant. Among the claims advanced for the installation are that each unit will deliver 62,500 horsepower or a total of half a million horsepower for the entire eight sets; the generator is one third smaller than any other design with a similar capacity; the ventilating system is designed on an original principle; the generator furnishes current at 13,200 volts and finally some of the castings in the turbine installation are the largest and heaviest ever made for this purpose. For example the turbine housing complete weighs 156,000 pounds; the exhaust housing alone weighs 127,000 pounds; one part of the condenser shell weighs 142,000 pounds and the entire condenser weighs 330,000 pounds. The stator frame weighs 50 tons.

It is apparent that the methods employed for making the molds for these castings should present many interesting features. Detail in connection with the condenser shell is shown in the accompanying illustrations. The shape is fairly simple and the task of making the mold would present no problem were it not for the enormous size. The shell is 22 feet 2 inches in length, 14 feet inside diameter, with a 11-foot opening at one side for the exhaust opening and a 48-inch opening on the opposite side. It is provided with a nozzle opening at each end, one 36 inches and the other 16 inches in diameter.

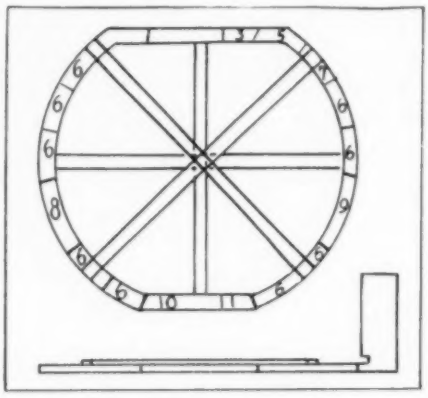
A cross made up of two bars each 4 x 6 inches, was cast at each end of the casting to hold it in shape and prevent distortion during the cooling period. A shelf or ledge extended

almost the entire length on two opposite sides on the inner surface, to form a reinforcement for a long bracket at a corresponding point on the outside. Each bracket on the outside contained 20 spring pockets, detail of which may be noted at the extreme lower left in Fig. 1. The circular shape of the casting is flattened somewhat at each end where it is enclosed by a flange 3½ x 5 inches.

Uniformity in size of castings, cost of production and durability of pattern equipment to serve for eight castings—and possibly others later—were the principal factors which influenced the adoption of the method herein illustrated. Long before the job was finished it was felt that all the foregoing requirements had been met in a gratifying manner.

In the first four castings the metal thickness averaged 1½ inches. This was increased to 2 inches for the remaining castings on the order. Also the cross bars bottom and top and the grating across the 11-foot opening omitted in the first few castings, were placed in all the others. These additions increased the estimated first weight of the castings by at least one third.

Patterns and coreboxes were made from a second grade southern pine 6 inches wide, 1⅝ inches thick. Regular pattern pine only was used where a considerable amount of hand work was required. Approximately 800 feet of lumber was used in making the pattern. Altogether 91 coreboxes were employed. The greatest number of cores made from any one corebox was 16. Another corebox was used to make 11 cores, all different from each other. The greater number of coreboxes only were used to make 2 or 3 cores for each casting and in some instances the corebox only was used once.



Pattern and coreboxes were built in a substantial manner to withstand the anticipated rough usage involved in making eight complete molds. On the large coreboxes the sides and ends were held together with bolts. After the core was made the bolts were taken out and the corebox was removed in sections from the body of sand. This arrangement dispensed with the necessity of rapping the box, or of providing any draft on the sides and ends. All coreboxes were held rigidly to the scratch in height, but an ⅛-inch clearance was allowed on the width. A shrinkage rule of 1/12-inch per foot was used on all height measurements. All other measurements were made with the regular patternmaker's standard shrink rule for iron.

The mold was built up on a level sand bed rammed on top of a cinder foundation in a concrete pit 10 x 22 x 22 feet. The bottom and top parts of the outside of the mold were made by assembling rings of cores. The space between was made up of sand rammed against a segment pattern that was drawn up gradually as the ramming progressed. The inside of the mold was formed by assembling eight rows of block cores in a circular wall and then packing the space inside full of sand. The space between the outside cores and the walls of the pit was rammed full of sand in a similar manner. Steel curbing was employed to retain the sand around that part of the mold which extended above the top of the concrete pit.

The wood templet shown in Fig. 3

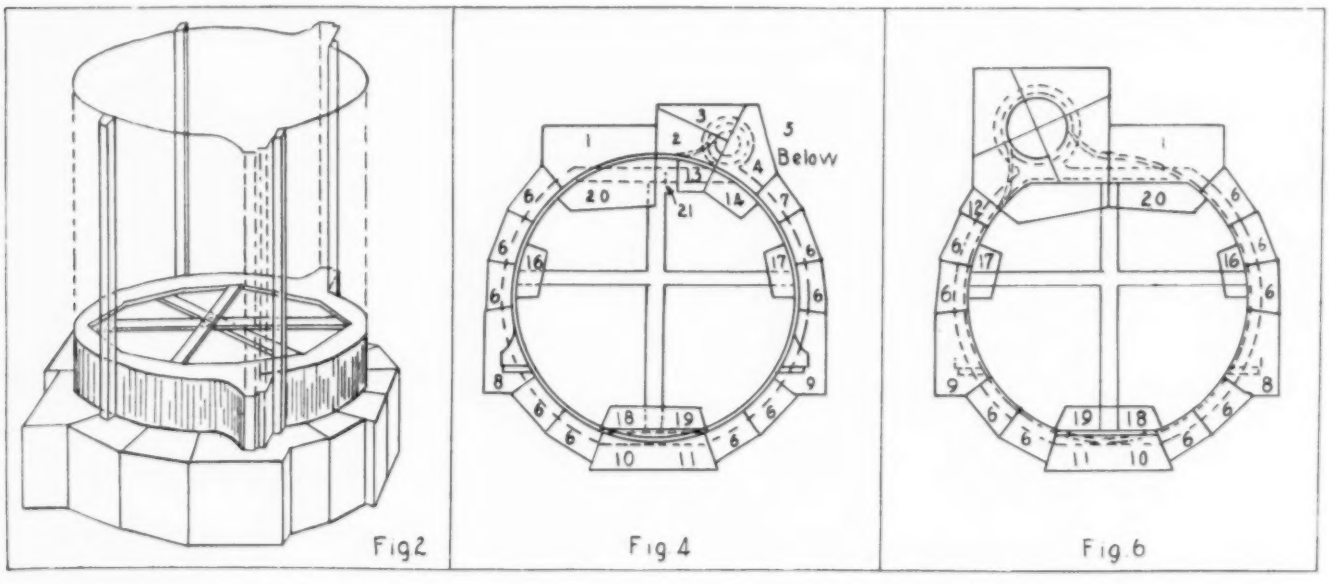


FIG. 2—PERSPECTIVE VIEW SHOWING APPLICATION OF PATTERN SEGMENT, GUIDES AND BOTTOM ROW OF OUTSIDE CORES. FIG. 3 ABOVE— WOOD TEMPLET FOR SETTING BOTTOM ROW OF OUTSIDE CORES. FIG. 4—BOTTOM ROW OF OUTSIDE CORES

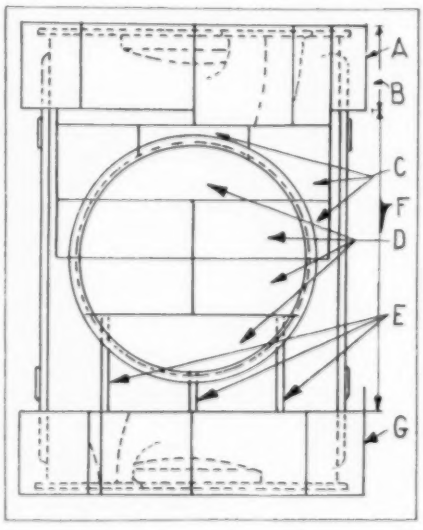


FIG. 5—*A* AND *B*—TOP ROW AND 36-INCH OUTLET CORES. *C* RAM-UP CORES FOR 11-FOOT OPENING. *D*—SECTIONS OF 11-FOOT OPENING PATTERN. *E*—SPACER STICKS. *F*—SPACE BETWEEN UPPER AND LOWER ROWS OF CORES TO BE RAMMED WITH SAND. *G*—BOTTOM ROW OF OUTSIDE CORES. FIG. 6—TOP ROW OF OUTSIDE CORES INCLUDING CORES FOR 36-INCH OUTLET

was placed on the level sand bed in the bottom of the pit and served as a guide in setting the ring of cores designed to form the outside of the lower end of the casting. The molder was provided with a blue print of the casting, also detail prints similar to Figs. 4, 6, 7, 9 and 12 showing the location of each individual core. Each core was given a definite number and in addition each corebox carried information indicating the number of cores required, number and position of loose pieces and the position for the lifting hooks. With this information available little difficulty was experienced in assembling the mold.

Reversible Cores

By referring to Fig. 6 it may be noted that the core numbers on this top row of cores are similar to the number of a great many of the cores used for the bottom row as shown in Fig. 4. The same corebox is used for both cores, but the lifting hooks are placed at opposite ends and the cores occupy a reversed position in respect to a center line.

The end of the casting with the 16-inch branch pipe was cast down and on account of its position it was necessary to place the inside core for the branch before assembling the outside cores in that vicinity. Part of the wood templet was loose at this point and was removed after the lower cores of the branch assembly were placed. The remaining cores enclosing the branch then were placed in position and were followed by any necessary slight adjustment in the position of the remaining cores in the ring.

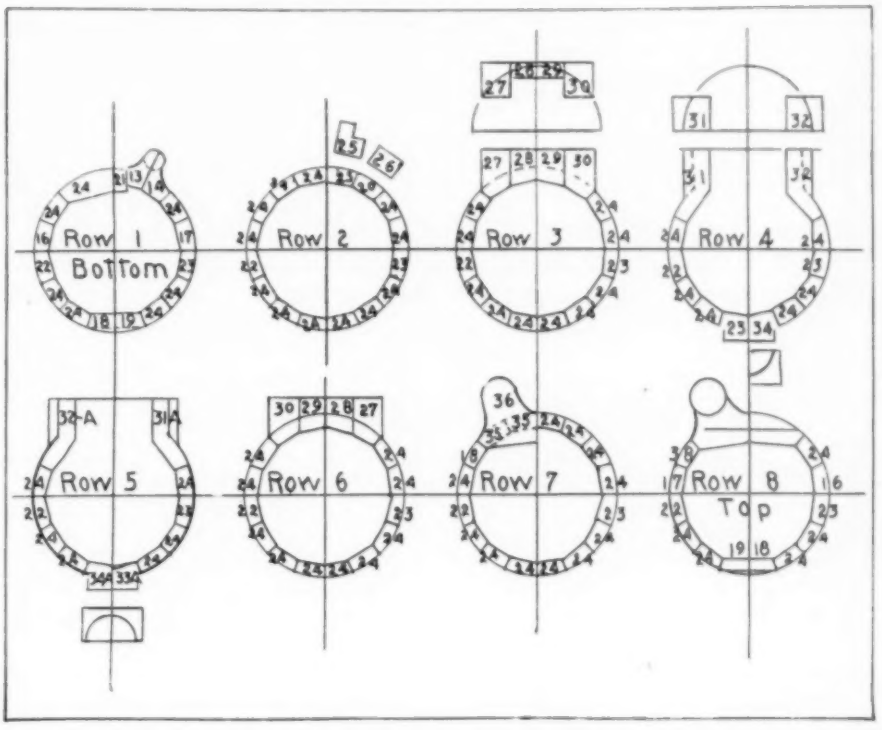


FIG. 9—DETAIL PLAN OF INSIDE CORE ASSEMBLY SHOWING LOCATION OF EACH CORE ACCORDING TO ITS NUMBER

The outside cores extended upward to a point beyond where the branch outlet washed or blended into the main body of the condenser shell. With this arrangement it was possible to set the lower edge of the pattern section down inside the core ring for a short distance before proceeding to ram sand against it. This feature is illustrated in the perspective outline Fig. 2, which also shows the arrangement of the upright guides by which the pattern ring was held in line on its upward journey.

A typical section of one of the outside cores is shown in Fig. 3. It may be noted that the sand below the flange touched the ring templet. This shoulder later served as a guide to set the inside row of cores and determined the metal thickness of the casting. Heap sand was rammed firmly between the outside cores and the walls of the pit.

Many Loose Sections

The distance between the upper and lower rows of flange cores is about 15 feet 6 inches. That part of the outside of the mold was formed by ramming successive courses of sand against a sectional pattern that was drawn upward 6 inches at a time. The four posts by which the pattern section was guided were erected at points where their presence would not interfere with projecting parts attached to the pattern temporarily. They were plumbed accurately and

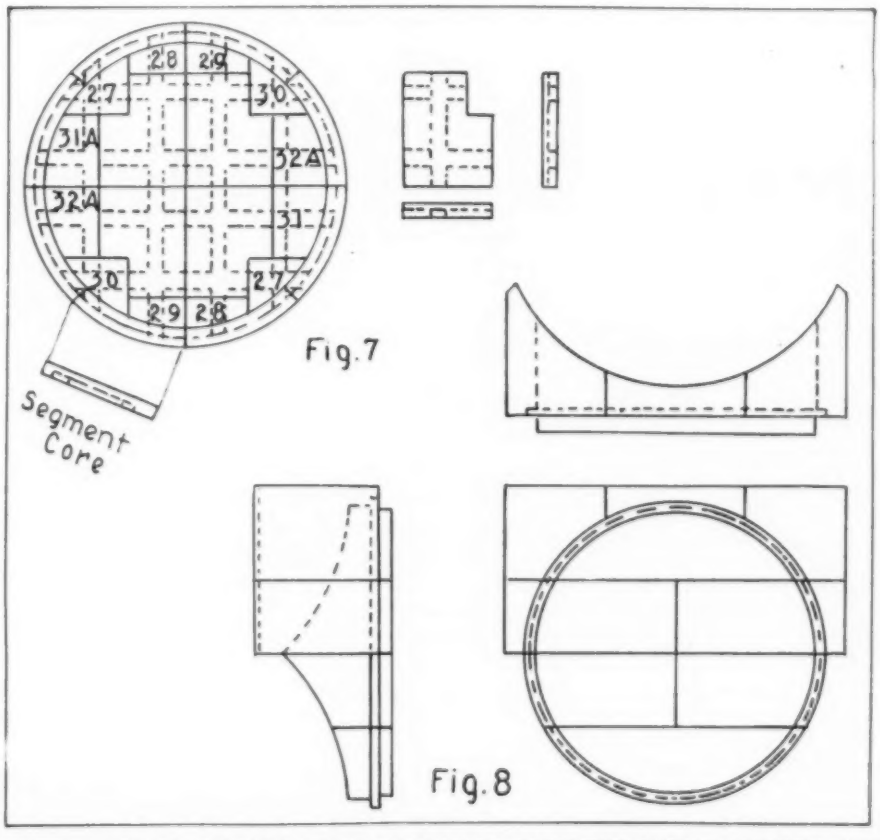


FIG. 7—SHOWING ARRANGEMENT OF CORES TO FORM THE 11-FOOT OPENING AND THE SHRINK BARS CAST ACROSS THE MOUTH. FIG. 8—METHOD OF APPLYING RAM-UP CORES TO 11-FOOT OPENING

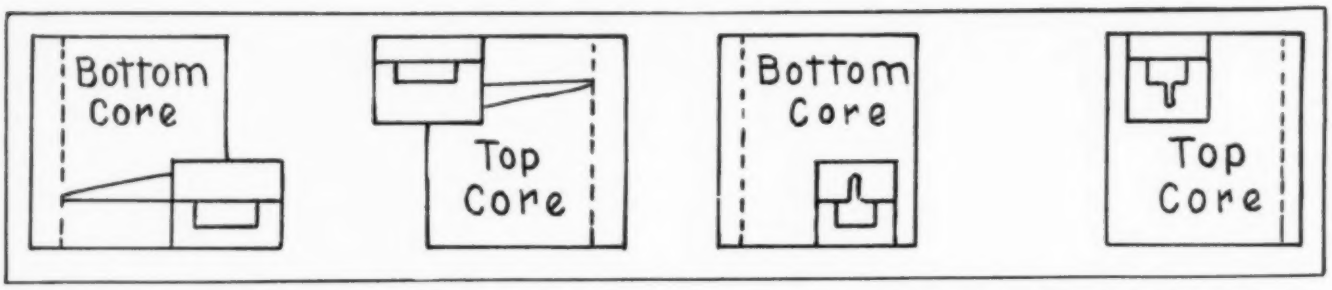


FIG. 10—CROSS BAR CORES SHOWN ASSEMBLED WITH INSIDE CORES. OTHER VIEWS OF THESE CORES ARE SHOWN IN FIGS. 4 AND 10

the upper ends were secured rigidly to the sides of the pit by suitable braces. The various loose parts were located in their proper positions by spacer sticks cut to the right length and tacked to the pattern. Application of these sticks to the pattern section for forming the 11-foot opening in one side of the casting, is illustrated in Fig. 5. Suitable vents and reinforcing rods were provided on every course of sand.

The loose part of the pattern designed to form the 11-foot opening was made in six sections for convenience in assembling and storing. The staves in the lower part of this pattern were set closely together because the sand was rammed directly against them. Above the center line only a sufficient number of staves were employed to outline the shape and serve as a support for three cores that were employed instead of the usual drawbacks to form the upper part of the arch. A row of segment cores was rammed in place around the main core print. These cores contained impressions to form the outer ends of the cross bars shown in Fig. 7. They also present a hard face for the reception of the inside cores later.

After the three ram-up cores were adjusted over the pattern for the 11-foot opening the remainder of the outside wall of the mold was rammed to the top of the guide posts. Here it was struck off level and true to form a seat for the top ring of cores,

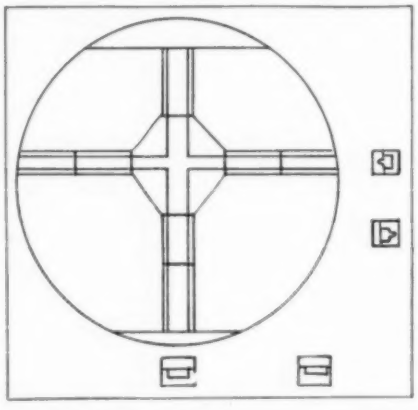


FIG. 12—CROSS BAR CORE ARRANGEMENT

but the cores were not placed in position until after the mold was dried.

Set The Inside Cores

The ring section of the pattern was drawn first, this was followed by the three ram-up cores which were lifted and placed to one side. The pattern for the 11-foot opening was removed in sections and then the guide posts, spacer sticks, and the templet on the bottom were lifted out. Long, rectangular cores were tucked into the gaps left by the guide posts and after the face of the mold had been finished, nailed and blackwashed, a gas burner was suspended on the inside and left burning until the mold was dried.

The inside of the mold was built up with eight rows of cores, with 16 cores to a circle, each core measuring 34½ inches in height, 33 inches in width and 14 inches in thickness. The cores were made from a mixture containing 25 per cent old molding sand, 25 per cent new molding sand and 50 per cent sharp sand bonded with a dry binder. A coat of blacking was applied to the convex face of each core. The layout of each row of cores from the bottom to the top of the mold is shown in Fig. 9. Each core was numbered and the setting was commenced at four center lines on each circle. Layout of the cross bar cores showing construction for both top and bottom is shown in Fig. 12. The manner in which the inside cores were cut away to form a joint with the cross bar cores is shown in Fig. 10. The cores for the cross bars were laid upon a level bed back down and the opening on the upper

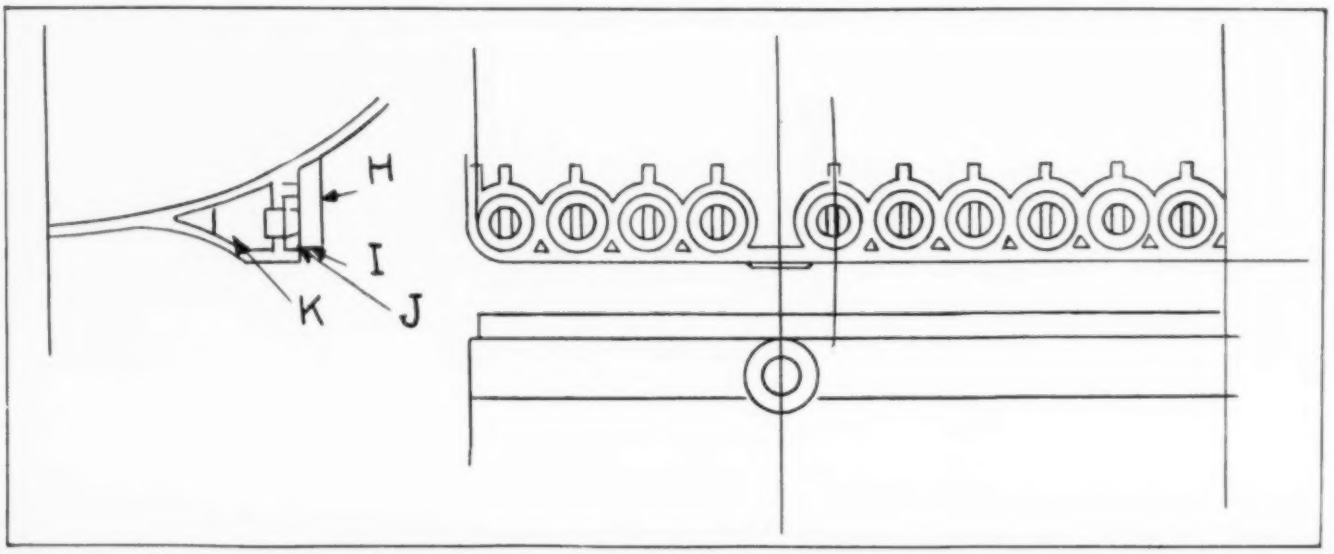


FIG. 11—CENTER AND END SECTION OF THE SPRING POCKET FOOT CORE. DETAIL OF ASSEMBLY IS SHOWN TO THE LEFT

LARGE CASTINGS ARE FINISHED UNDER SWING FRAME GRINDERS FITTED WITH MANUFACTURED ALUMINA WHEELS

side was covered with plain slab cores.

Cores on the bottom inside row were guided into place by the projection on the lower face of the ring of outside cores. Succeeding rows of cores were held at the proper distance by chaplets. In the third row irregular shaped cores were placed to form the 11-foot opening. These irregular shaped cores were continued through to the sixth row as may be noted in Fig. 7 where an end view of these cores is shown. The numbers correspond to those in Fig. 9 and the heavy lines indicate the core divisions. These cores did not fill the entire opening and therefore a set of slab cores was provided to form a continuation of the rectangular grating shown in Fig. 7. The space inside the large cores was packed full of heap sand against a number of slab cores arranged to form a flat face in line with the opening. The slab cores containing the bar impressions then were laid up against the plain slabs and heap sand was packed behind them to hold them in place.

Cores for the spring pockets were made in four sections for convenience in handling and were adjusted in place as the building of the inside wall of the mold progressed. The divisions are shown in Fig. 12. The first division was just above the point where the 6-inch opening was cored through the casting. The 6-inch core was set and secured with chaplets before the second section of the spring pocket core was placed in position.

After the cores for the inside of the 11-foot opening had been assembled in place and after the cores forming the inside vertical wall of the mold had been built up to a point opposite the center of the opening, the ram-up cores were replaced. They were supported on outside bearings and also on chaplets resting on the inside cores.

Stacking of the inside wall cores continued to a point where the upper surface came flush with the core seat formed on the outside wall of the mold. The top row of cores as shown in Fig. 6 was adjusted in place. This includes the group required to form the 36-inch outlet. The outside cores making up this outlet were split as shown in Fig. 6 and were divided at nearly the same height as the normal inside cores. With this arrangement it was possible for the molder to note the inside and outside and adjust the cores to insure a uniform thickness of metal in that part of the casting.

After these cores were set the remaining space inside the curbing was rammed full of sand. The eighth or top row of inside cores then was placed in position and sand was rammed to the proper height to receive the cores for the cross bars. After these cores were set the space inside the ring of cores was rammed full of sand. Coke vents were carried in four places from the bottom to the top and in such positions that they cleared the cross-bar cores.

A circular reservoir runner was built on top of the mold with sufficient capacity to hold a quantity of metal during the time required to change ladles. In this manner a continuous flow of metal was insured into the mold. Twelve upright runners carried the metal from the pouring basin to a great many points on the face of the casting. The gates were formed in the cores. Additional runners were placed over the 36-inch outlet and the 11-foot opening. These runners were provided with plugs and the metal was not allowed to enter until the mold was partly filled through the other runners.

Discuss Illumination

The National Lamp Works of the General Electric Co., Cleveland, has published a booklet entitled "Light and Vision." The booklet presents basic investigations on the relation between illumination and the speed of vision. The results of these investigations show clearly why workmen can turn out better work with lers effort under good illumination. The material is prepared in such a way as to be interesting and understandable to the nontechnical reader.

Casts Large Exhaust Hood

THE foundry of the General Electric Co., at Schenectady, N. Y., recently cast one half of the exhaust hood of a 60 000-kilowatt turbine. The casting, which is shown in the accompanying illustration, is the largest ever produced at that plant. It measures 26 feet, 8 inches in overall length and the total length is 129,300 pounds. A special pit was dug in the foundry to accommodate it. The men shown in the illustration are the coremakers, molders, chippers, etc., who worked on the job and are as follows from left to right: John Heim, coremaker; Henry Gould, foreman of coreroom; John DeCarlo, chipper; James Baume foreman of molders; Richard Eagle, coremaker; Benjamin Cook, molder; John Skurmiski, coremaker; Steve Laviecha, chipper; C. Burgett, chipper; Frank Kennedy, coremaker; and Gilbert Cator, assistant foreman of molders.

Probe Aluminum Castings With the X-Ray

By Robert J. Anderson

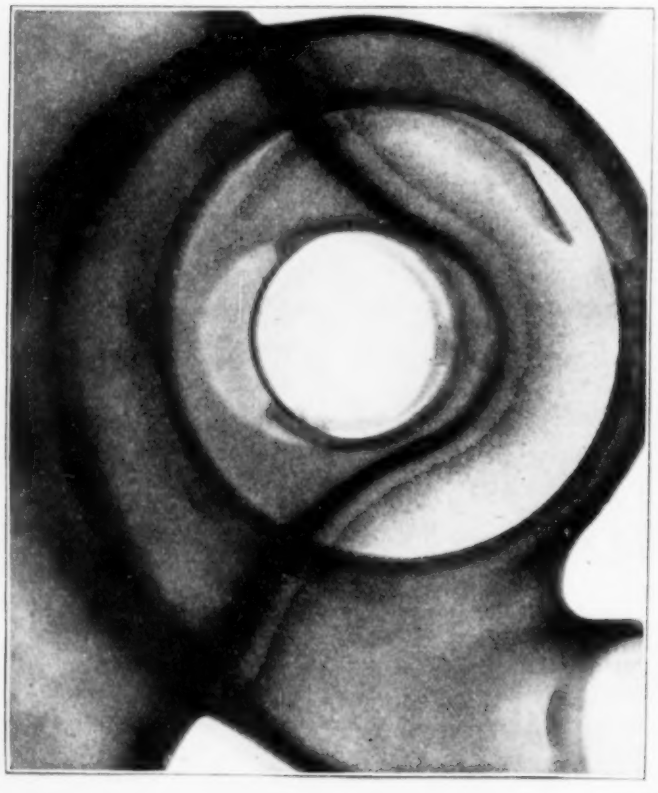
EXAMINATION of castings for internal flaws and defects by X-rays is a comparatively recent developement, but it promises to be one of the most important testing methods in foundry practice. It is adapted particularly well to aluminum-alloy castings because aluminum is relatively transparent as compared with steel, and satisfactory radiographs may be taken with short exposures.

The bulk of the practical metal radiography carried out so far has been in connection with steel castings, the work of Lester at the Watertown arsenal particularly being well known. It is of special interest to foundrymen that this work has been concerned in considerable part with the diagnosis of casting defects, as shown by radiographs, and the correlation of defects with gating practice. So far, the X-ray method has been employed but little in the nonferrous field.

The advantages of X-ray examination in the production and use of castings may be summed up as follows: Inspection may be made of parts without cutting or otherwise damaging them; dangerous flaws, which might cause failure of a part, may be detected before the part is put in service; flaws, which might be uncovered on machining and then cause rejection of the part, may be located before expensive machine work is done; correlation of the nature, amount, and distribution of the internal defects in castings may be made with the method of gating or some other factor, thus giving direct information as to the causes for flaws; and soundness may be ensured, thus permitting the use of smaller sections and a lower factor of safety, with simultaneous decrease in cost. The main disadvantage of the X-ray examination is the high cost. This is particularly expensive where high-voltage tubes and deep therapy apparatus are required as for steel. The cost for aluminum-alloy examinations would be relatively low when using radiator-type tubes. In any case, a skilled operator is required.

The status of any casting as regards internal flaws and variable thickness in different parts may be determined fully by the X-ray examination up to the limits of pene-

FIG. 3—END OF FORGED DURALUMIN CONNECTING ROD; 165 KILOVOLTS, 2 MILLIAMPERES, 15 SECONDS WITH SCREEN, REDUCED ABOUT ONE-HALF



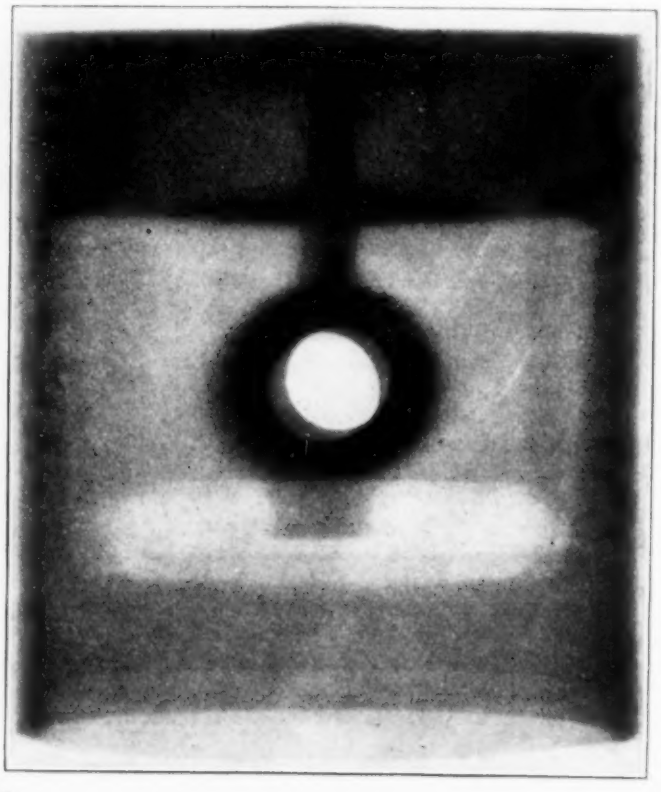


Fig. 1—Vacuum Cleaner Casting: 165 Kilovolts, 2 Milliamperes, 12 Seconds With Screen, Reduced One-Half. Fig. 2—Chill Cast Piston: 165 Kilovolts, 2 Milliamperes, 30 Seconds With Screen, Reduced One-Fifth

FIG. 4—UNSOUNDNESS IN SIDE WALL OF AVIATION ENGINE CRANKCASE; 55 KILOVOLTS, 18 MILLIAMPERES, 15 SECONDS. FIG. 5—FLAW IN CRANKCASE; 55 KILOVOLTS, 18 MILLIAMPERES, 12 SECONDS. FIG. 6—SOUND SIDEWALL OF MOTOR CRANKCASE; 165 KILOVOLTS, 2 MILLIAMPERES, 180 SECONDS

tration. The number of radiographs required in the survey of a casting depends, necessarily, on the size and contour of the part and the nature of the information desired.

Radiographs are shadow pictures, and the image produced on the plate or film is actual size. Briefly, a radiograph is made by exposing a photographic plate or film to the X-radiation from a coolidge tube passed through the part to be examined. The film is placed in close contact with the surface of the part, and the tube is situated at a considerable distance from the part, (say 30-42 inches) to avoid fogging the definition. The fluoroscopic method, as employed in medical work, is not used for metals. The theory of X-ray transmission through a metal need not claim attention here, but

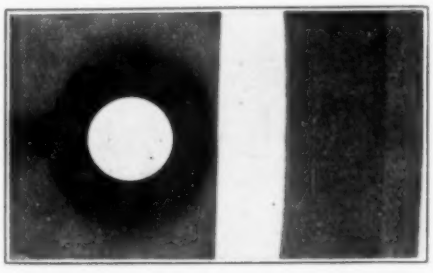


FIG. 7—SKIRT RIM AND BOSS OF CHILL CAST PISTON; 165 KILOVOLTS, 2 MILLIAMPERES, 180 SECONDS. REDUCED ABOUT ONE-HALF

briefly, opacity to X-rays, or the transparency of a substance, is determined by the number and weight of the atoms. Aluminum is much more transparent than iron.

The apparatus required for radiography is known well and has been described frequently. For penetrating heavy sections of steel, the high-voltage coolidge tube operating up to 260 kilovolts is suitable. A self-rectifying unit, with radiator-type coolidge tube, capable of operation in the range 50-90 kilovolts generally is suitable for aluminum. A radiator-type tube with auto-transformer may be purchased for around $700, which makes an economical proposition, but the installation of a deep-therapy machine with high-voltage tube and the necessary auxiliary equipment costs between $6000 and $7000.

One of the main objections to the radiography of steel is the long exposure required for penetrating any considerable thickness of section with the tubes now available. With the high voltage tube operating at 200 kilovolts and 7 milliamperes, the time required for penetrating 3 inches of steel is about 30 minutes. If 400 kilovolt tubes were available, 6.8 inches of steel could be penetrated in 30 minutes, according to Lester. Thirty minutes is a practical exposure limit, but the shorter the time, the better from several points of view.

Requires Less Exposure

In contrast to steel, aluminum and its light alloys are relatively transparent, and penetration of comparatively heavy sections may be made in short times. Thus, a section 2.5 inches thick may be penetrated to give a good radiograph with an exposure of 30 seconds, using 165 kilovolts and 2 milliamperes, with an intensifying screen, or 3 minutes without a screen. Thickness of 3/16-inch may be penetrated in 5 seconds, with screen, or about 20 seconds, no screen, under 165 kilovolts, 2 milliamperes. Using radiator type tube operating at 90 kilovolts, 22 milliamperes, no screen, the exposure may be from 10 seconds for 3/16-inch thickness to 90 seconds for 2.5-inch thickness. In any case, it may be necessary to make several different exposures at a given section to secure an X-ray negative of the desired density to give good prints and to show well the particular flaws present.

Blowholes, draws, cracks, and related defects in castings appear as dark areas on the X-ray negatives or as light areas on the X-ray prints. Inclusions would appear as light spots on the negatives if the included matter were more opaque than the matrix of the casting.

Various representative aluminum-alloy castings, including crankcases for aviation engines and automobile motors, pistons, vacuum cleaner parts, housings, runners and gates, etc., have been examined recently by the author in the X-ray laboratory of the Massachusetts Institute of Technology. To determine the status of the casting, in the case of large parts

FIG. 8—FLANGE OF VACUUM CLEANER NOZZLE; 90 KILOVOLTS, 22 MILLIAMPERES, 12 SECONDS

like crankcases, it is advisable to survey the part by the method of taking numerous small radiographs at virtually all feasible positions. In the survey, for example, of a crankcase upper half for a 12-cylinder aviation engine, some 90 radiographs were taken. The accompanying radiographs shown in Figs. 1 to 12, inclusive, give some typical results obtained on different castings.

Fig. 4 is a radiograph taken through the wall on one side of a 12-

cylinder aviation engine crankcase at a position between the second and third bearing ribs. The light areas are unsound portions. Fig. 5 is another radiograph taken through a side wall of the same case between the fourth and fifth bearing ribs, showing a bad flawed area.

Fig. 10 is a radiograph taken through a portion of an end wall of a crankcase for an 8-cylinder automobile motor. The numeral four appearing dark was cast integral with the wall, being a small identification number, raised about 1/16-inch above the surface of the wall. Blowholes are shown in this radiograph by the light areas. Fig. 11 is a radiograph taken through a portion of a wall of this crankcase at the bell end, at the position of a large cored hole. Variation in thickness of adjoining sections is shown. Fig. 12 is a radiograph taken through a bearing rib of this case and shows a large hole and the outlines of the rib. Fig. 6 is another radiograph taken through a side wall of this case, showing a generally sound structure and the outlines of small raised numerals cast in the wall.

Fig. 2 shows the silhouette of a chill-cast piston for an automobile motor, the variable thickness of the different sections being plainly evident. Fig. 7 is a radiograph taken through the skirt rim and boss of a similar piston, showing good sound metal. Fig. 9 shows a radiograph of a gate and runner system cut from a casting; the light area at the juncture is an external draw. Fig. 8 is a radiograph taken through the flange of a vacuum-cleaner nozzle, showing some little unsoundness, and Fig. 1 shows the silhouette of a vacuum-cleaner casting. Fig. 3 is a radiograph of a forged duralumin connecting rod, showing absence of flaws.

X-ray examination will go far in throwing light on the reasons for specific gating methods and the causes for wasters due to improper gating. Radiographs may show readily such flaws as blowholes, draws and shrinkage cavities, inclusions, porosity and general unsoundness, cracks, variations in thickness, such as caused by core shifts, and other defects commonly found in commercial castings.

It is of interest to point out that during the course of examination of a variety of aluminum-alloy castings made by three usual casting methods, namely sand, die, and permanent mold, the radiographs invariably showed that the permanent mold cast product is uniformly sound throughout as contrasted with die castings which are exceedingly porous and contain many blowholes beneath the surface skin and with sand castings which generally show a more or less porous condition. Permanent-mold castings do show isolated blowholes, but these generally are small. Soundness in castings is desirable to avoid large sections and excess metal to compensate for porosity.

Exposures for radiography of aluminum-alloy castings are short as compared with steel. Radiator-type tubes, which, together with the necessary auxiliary equipment, are comparatively inexpensive, are suitable for the radiography of the general run of aluminum-alloy castings. The writer is of the opinion that producers of aluminum-alloy castings might profitably inquire into the application of X-ray examination as a practical control test in regular production.

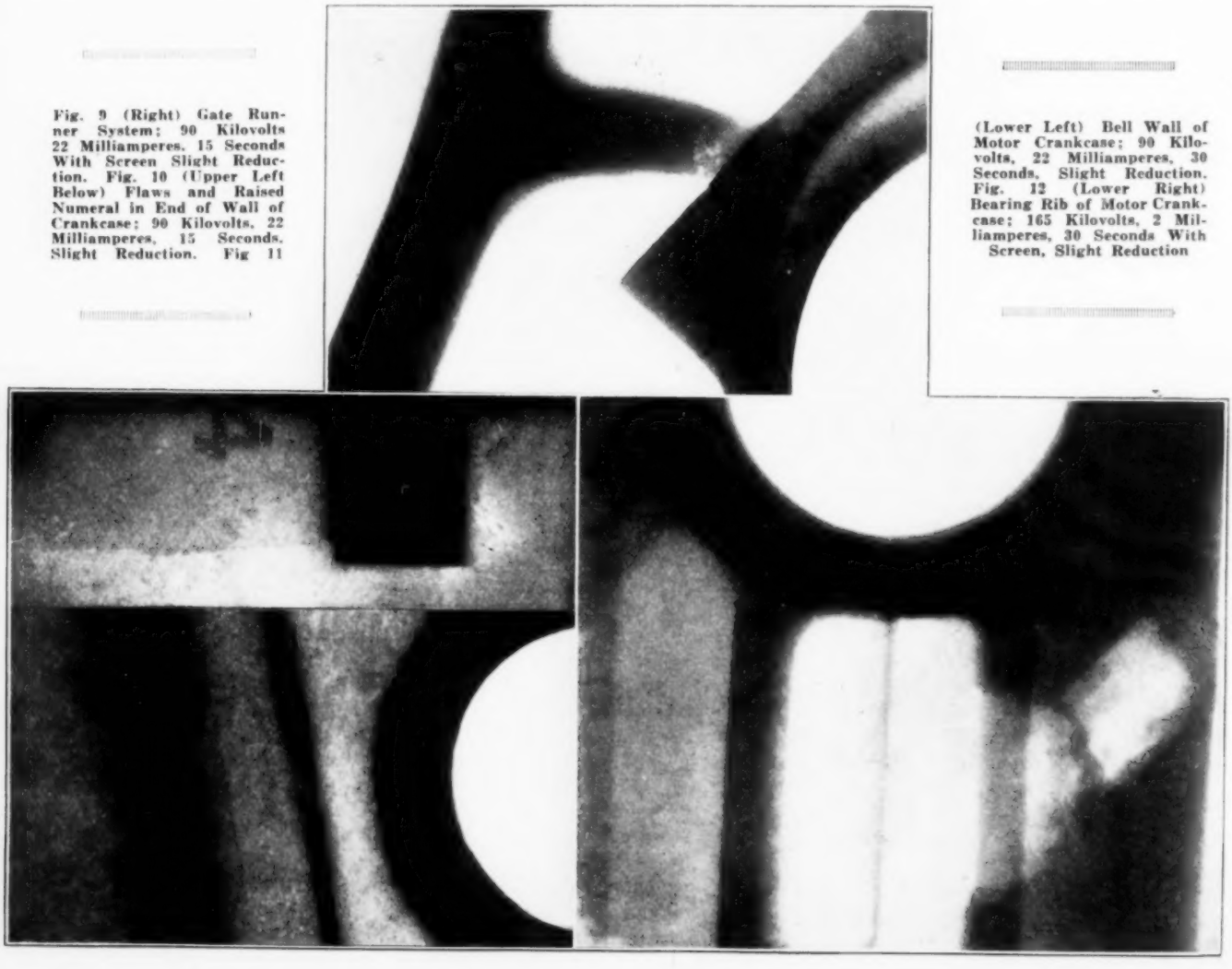


Fig. 9 (Right) Gate Runner System; 90 Kilovolts 22 Milliamperes, 15 Seconds With Screen Slight Reduction. Fig. 10 (Upper Left Below) Flaws and Raised Numeral in End of Wall of Crankcase; 90 Kilovolts, 22 Milliamperes, 15 Seconds, Slight Reduction. Fig 11 (Lower Left) Bell Wall of Motor Crankcase; 90 Kilovolts, 22 Milliamperes, 30 Seconds, Slight Reduction. Fig. 12 (Lower Right) Bearing Rib of Motor Crankcase; 165 Kilovolts, 2 Milliamperes, 30 Seconds With Screen, Slight Reduction

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

REDUCTION IN AREA OF 0.505-INCH BARS

(Concluded from Data Sheet No. 582)

Diameter	Area	Per Cent Reduction in Area	Diameter	Area	Per Cent Reduction in Area
0.372	0.1087	45.73	**0.411**	0.1327	33.75
0.373	0.1093	45.43	**0.412**	0.1333	33.45
0.374	0.1099	45.13	**0.413**	0.1340	33.10
0.375	0.1104	44.88	**0.414**	0.1346	32.80
0.376	0.1110	44.58	**0.415**	0.1353	32.45
0.377	0.1116	44.28	**0.416**	0.1359	32.15
0.378	0.1122	43.98	**0.417**	0.1366	31.80
0.379	0.1128	43.68	**0.418**	0.1372	31.50
0.380	0.1134	43.38	**0.419**	0.1379	31.15
0.381	0.1140	43.09	**0.420**	0.1385	30.85
0.382	0.1146	42.79	**0.421**	0.1392	30.50
0.383	0.1152	42.49	**0.422**	0.1399	30.15
0.384	0.1158	42.19	**0.423**	0.1405	29.86
0.385	0.1164	41.89	**0.424**	0.1412	29.51
0.386	0.1170	41.59	**0.425**	0.1419	29.16
0.387	0.1176	41.29	**0.426**	0.1425	28.86
0.388	0.1182	40.99	**0.427**	0.1432	28.51
0.389	0.1188	40.69	**0.428**	0.1439	28.16
0.390	0.1195	40.34	**0.429**	0.1445	27.86
0.391	0.1201	40.04	**0.430**	0.1452	27.51
0.392	0.1207	39.74	**0.431**	0.1459	27.16
0.393	0.1213	39.44	**0.432**	0.1466	26.81
0.394	0.1219	39.14	**0.433**	0.1473	26.46
0.395	0.1225	38.84	**0.434**	0.1479	26.16
0.396	0.1232	38.49	**0.435**	0.1486	25.81
0.397	0.1238	38.14	**0.436**	0.1493	25.46
0.398	0.1244	37.89	**0.437**	0.1500	25.11
0.399	0.1250	37.59	**0.438**	0.1507	24.76
0.400	0.1257	37.24	**0.439**	0.1514	24.41
0.401	0.1263	36.94	**0.440**	0.1521	24.06
0.402	0.1269	36.65	**0.441**	0.1527	23.76
0.403	0.1276	36.30	**0.442**	0.1534	23.41
0.404	0.1282	36.00	**0.443**	0.1541	23.07
0.405	0.1288	35.70	**0.444**	0.1548	22.72
0.406	0.1295	35.35	**0.445**	0.1555	22.37
0.407	0.1301	35.05	**0.446**	0.1562	22.02
0.408	0.1307	34.75	**0.447**	0.1569	21.67
0.409	0.1314	34.40	**0.448**	0.1576	21.32
0.410	0.1320	34.10	**0.449**	0.1583	20.97

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

CALIBRATING PYROMETERS

Carefully standardize each pyrometer at definitely stated intervals, at least once a week, and as much oftener as possible. Frequent calibration is a matter not of convenience, but of necessity. Do not imagine that this practice will reduce production, for on the contrary it will increase the output of parts properly heat-treated.

The easiest and most convenient method of calibrating a pyrometer is based on the melting point of pure table salt, *sodium chloride*. Chemically pure salt is recommended on account of variations in the melting point of common salt caused by impurities. The salt is melted in a clean crucible of fireclay, iron or nickel, either in a furnace or over a forge fire, and then further heated until a temperature of about 875 degrees Cent. to 900 degrees Cent. or 1607 degrees Fahr. to 1652 degrees Fahr., is attained.

It is essential that the crucible be clean because a slight admixture of a foreign substance might noticeably lower or raise the melting point. The thermo-couple to be calibrated is removed from its protecting tube and its hot end is immersed in the salt bath.

When this end has reached the temperature of the bath, the crucible is removed from the source of the heat and allowed to cool, and while cooling, readings are taken every 10 seconds on the volt-meter. A curve is plotted, using time and temperature as co-ordinates, and the temperature of the melting point of salt, as indicated by this particular thermo-couple, is noted at the point, namely, where the temperature of the bath remains temporarily constant while the salt is freezing. The length of time during which the temperature is stationary depends on the size of the bath and the rate of cooling, and is not a factor in the calibration. The melting point of salt is 801 degrees Cent. or 1474 degrees Fahr., and the needed correction for the instrument under observation may be applied.

Around the World with The Foundry

Little Journeys to the homes of our readers

Cuba

TWENTY degrees north of the equator, in the midst of a group of lesser isles, the Queen of the Antilles basks in the warm waters of the Caribbean Sea smiling and alluring as on the day when Columbus declared it to be the fairest land on which the eye of man ever had rested. Truly she must have appeared a paradise to the navigator whose indomitable courage had driven the Nina, the Pinta and the Santa Maria manned with insubordinate crews across 3000 miles of strange and stormy water.

The same haughty and mistaken royal policy which refused Columbus recognition for his marvelous work finally was the means of losing to Spain the fairest and most important of her colonial possessions.

Under the suzerainty of the United States and recently as an independent republic Cuba has prospered to an amazing degree. Immense sugar plantations scattered all over the island pour a constant stream of cane into the mills where the juice is extracted, boiled, evaporated and finally shipped to the extent of several million tons a year

Many of the Cuban foundries compare favorably with those in any part of the world and one of the factors which helps to maintain this condition is The Foundry which is delivered twice a month to 5 of the leading foundry executives on the island.

"Wherever metals are cast you'll find THE FOUNDRY"

How and Why in Brass Founding

By Charles Vickers

To Color Solder for Brass and Bronze

We would like to know how to color solder so that it will have the same color as brass and bronze castings, and thus be used to fill up holes in the same. The alloy should have a low melting point, and take a polish.

We know of no combination of metals that will produce a colored soft solder, and neither can we say whether a heat-resistant dye could be added to soft solder to color it. Such dyes are obtainable from dealers in chemicals, but whether they may be mixed with solder without decomposition, or if so mixed would color the same is unknown to us. It is not difficult to find out; simply buy the dyes and try it. For obvious reasons it would be safer to turn the matter over to some organic chemist to make the experiments.

Some people fill holes in brass castings by heating plumbers' solder to plasticity, and while maintaining the heat for a while stir in filings of the alloy it is desired to imitate. When it is judged sufficient has been added the mixture is allowed to cool, stirring as required to maintain a good admixture. This is used like solder, the holes being fluxed the casting heated and the solder rubbed in. However, it is far preferable to make the casting sound in the first place, as there is no need of having bad spots or holes in brass castings, save those made with a core. It is all a question of skill in molding, melting and pouring the castings.

Lead May Be Added

We are making a brass to withstand an air pressure of 200 pounds per square inch. At first we used the alloy 85, three fives, but had a large percentage of leakers. We then increased the lead and reduced the number of rejections, and now the customer wants us to put in still more lead. We desire to learn how to do this and have the lead remain in solution after the alloy has solidified.

No trouble should be experienced in doubling the lead content if it is thought desirable to do this. Sometimes the tin is raised and sometimes the lead, thus producing modifications of this alloy suitable for a variety of purposes. Increasing the tin, of course increases the hardness of the alloy, and increasing the lead improves it for the purposes of a bearing metal. Thus for the latter purpose the lead usually is raised to 20 per cent, the copper being decreased accordingly.

Seal Brass Castings with Silicate of Soda

We recently cast several venturi tubes, about 125 pounds in weight, using ingot metal of the composition 88-10-2 melted in coke-fired furnaces under charcoal, and poured at a hot temperature. The castings were allowed to cool in the molds and appeared to be first class even when machined, but on testing them with water pressure, it was found that some of them would sweat around the top flange, where the metal is about 2 inches thick. These castings sweated at 65 pounds pressure, but no other leaks appeared, even at over 400 pounds pressure. We have made these castings before under the same conditions and experienced no trouble, and as the present lot have been machined at considerable expense could you advise if any method could be used to seal the leaky parts? Also kindly advise how we may avoid this difficulty in the future.

The leaks may be sealed by driving in water glass, otherwise known as silicate of soda. Regarding the procedure we have no definite information, but should think it would be necessary to fill the castings with a watery solution just sufficiently liquid to enter the pores and show as sweat on the outside. Time for drying should be allowed, then should any leaks show when tested with water, the process of sealing will have to be repeated. Porous areas thus sealed are said to be permanent.

Such troubles in the future may be guarded against by using chills under the heavy flanged portion. For this service nothing equals graphitized carbon, which may be machined like wood, and may be built up with the mold, using a facing for the sand that adjoins the chills that is bonded with silicate of soda. These chills must be hot at the time the mold is poured, otherwise they will blow.

Heat Kettles Separately

We are melting zinc in iron kettles with two kettles in series or tandem. The first kettle does not melt as fast as the kettle in its rear, the latter kettle of zinc being ready to pour before the first kettle of metal is melted. We would like to know how to construct the furnace so that both kettles of metal will be melted at the same time.

One kettle melts faster than the other because it is situated in a zone of more perfect combustion. The kettle nearest the firing end of the installation fails to get full heat until the fire has burned to incandescence. Make separate installations, each kettle being set in its own brickwork and having its own firing place. Both settings may be attached to the one chimney, but either may be used independently. Should one melt faster than the other, the latter may be given a start sufficient to bring both kettles to the desired temperature at the same time. Set the kettles sufficiently back of the fire to melt well. Data for managing this may be obtained from the performance of the present rear kettle.

Metal for Statuary

We desire to obtain a good formula for a bronze suitable for casting memorial tablets, honor rolls and statuary.

In the manufacture of tablets and statuary the cost of the metal is a small item compared with the cost of molding. Therefore, no chances are taken of losing a casting due to some defect introduced by the alloy, such as zinc smoke, which is difficult to guard against when using an alloy comparatively high in zinc. It also is necessary that the metal be fluid to avoid the possibility of *cold shuts* and this property is gained by the amount of tin present, it being necessary to have the metal fairly high in tin. The following alloy will be suitable for tablets, rolls and statuary.

ALLOY FOR TABLETS

	Per cent
Copper	90
Tin	6
Zinc	3
Lead	1

Stop Foundry Accidents!

Large Eastern Firm Cuts Foundry Accidents by Intensive Safety Education

By Luther D. Burlingame

IN 1924, the works, including the foundry of Brown & Sharpe Mfg. Co., Providence, R. I. made a creditable record as the result of active measures for accident prevention. To maintain and to arouse interest still further, a speaker was invited to visit Providence and to speak to the foremen and safety committeemen. This speaker, C. C. McDonald, Wickwire-Spencer Steel Corp., Worcester, Mass., brought a forceful message, and told the foremen and safety committeemen to shoulder the responsibility of preventing accidents in the factory. There had been but 51 lost time accidents, few of them serious, among 3300 employes during the first half of the year and the challenge was to reduce this by one-half during the remainder of the year. The efforts of safety committeemen and foremen were redoubled and the co-operation of the Providence safety council was secured. The result was that the number of accidents for the remainder of the year was reduced practically to the goal set, and the foundry held its own with the other departments of the shop in bringing about this reduction.

Steps taken to secure safety in the foundry, may be divided into safeguarding and education. It must be borne in mind that it takes much educational effort to have efficient safeguarding and this doubles the importance of the educational features. The importance of the latter is further emphasized when it is borne in mind that in the average industrial plant not more than 15 per cent of the accidents are due to lack of safeguarding, while 85 per cent are nonmechanical, and traceable to somebody's carelessness.

Burns are a major hazard of the foundry and much attention has been devoted to protect against them. The wearing of congress shoes and leggings while pouring is now an important factor in preventing burns. Men who have been in the habit of wearing old shoes and ragged clothing in the foundry, sometimes are hard to convince that it is to their own advantage to provide safety shoes and leggings, and to use these shoes only when in good condition. This requires constant watchfulness on the part of the foreman or the rule will be evaded.

The use of goggles while pouring is objectionable occasionally because the goggles become dirty or fogged and thus may become a hazard rather than a safeguard. Nonfogging goggles are being studied and it is hoped that a satisfactory type can be produced.

Cement floors in the pouring section should be covered by a thick layer of sand to avoid danger of the iron spattering on the hard surface causing injury, especially to the eyes.

Respirators have their place in connection with sand blasting and even for crane operators and others where provision for carrying off gases is inadequate.

When working in the cupola, trench helmets should be worn as a safeguard against material falling from above.

As heavy weights constantly are being handled, it is important to provide every possible safeguard against injury from their falling. Counterweights such as those on core oven doors can operate in loosely fitting tubes. When it is necessary to suspend a portion of the flask in order that a molder may work under it, *horses* should be provided as a protection in case of failure of the chain sling.

In the Brown & Sharpe foundry, heavy ladles of molten iron are transported to various parts of the pouring floor on overhead rails. These rails are provided with switches that all parts of the floor may be reached. Safety switches are provided which make it impossible for the carrier to run off the rail whichever way the switch is thrown.

The practice which has been fol-

Fig. 1—Elevator under spout closes the opening in the floor when small ladles are filled

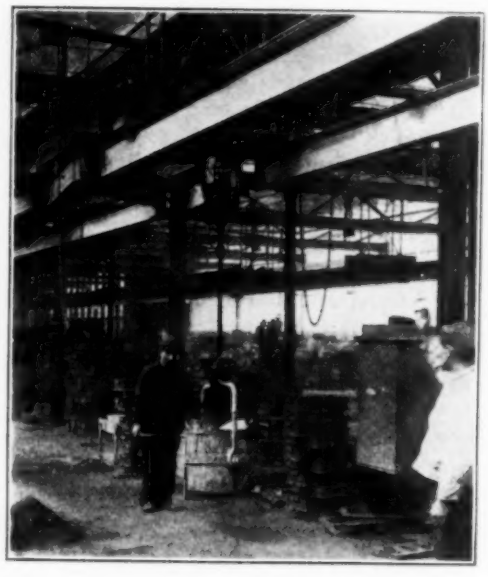


Fig. 2—A safety switch prevents the truck from running off the rail

Abstracted from a paper presented in the *National Safety News*.

lowed successfully in the foundry of the Brown & Sharpe Mfg. Co., is to test the chains as follows:

New chains are prick-punched at 3-foot intervals and a gage made by which the stretch of the chain is tested from time to time. When this stretch amounts to 1/3 of a link or more in this length, the chain is repaired or rejected. Foundry chains are inspected every six weeks.

Organize Committees

As already pointed out, educational methods prevent the greater percentage of accidents. However, these methods are intangible and for that reason may be difficult to visualize or to form definite plans for carrying out. To stimulate interest and to bring about a sense of personal responsibility a safety committee which holds meetings from time to time should be organized. Duties of such committee members may be not only to report hazards, but also to investi-

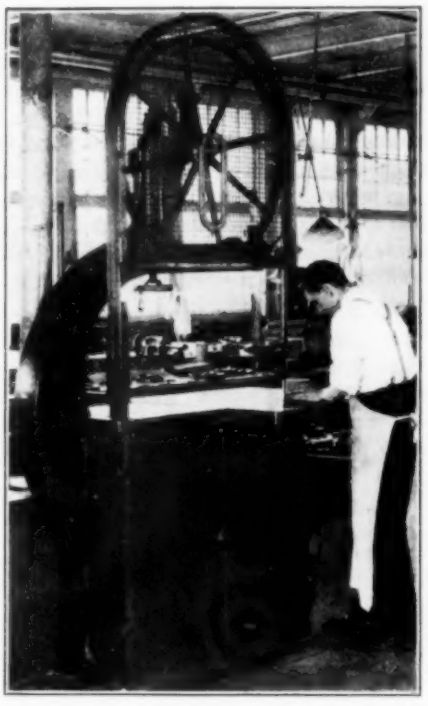


FIG. 3—GUARDED BAND SAW WITH EXHAUST WHICH REMOVES ALL SAWDUST EFFECTIVELY

gate accidents which have occurred. It should be one of their duties to interview new men, explaining to them the hazards of their work, and the desire for safety methods in the shop. This opportunity may be used to present printed instructions on safety methods. At the works of the Brown & Sharpe Mfg. Co., a 50 page booklet, *Health and Safety*, is provided for this purpose. It contains reports of accidents, analyses of causes of accidents which have occurred, the relative standing of departments, cartoons helping to impress lessons of safety, and besides this contains some simple and direct rules for health. This booklet is one which the workman and his family will keep.

Special instruction also should be provided for apprentices. Bulletin boards with notices and posters from the National Safety council, keep lessons of safety before all the employes. These bulletin boards also are used to post monthly reports of the standing of departments throughout the shop. This develops competition so each department will try to excell rival departments.

Each One Responsible

Another important factor in educating for safety is to instill into the minds of both workmen and foremen that safety work is one of the great and important activities of each day and that every man has a personal part and a personal responsibility for safety.

Whichever factory or foundry carries out the program that has been outlined will find that among the great number of accidents which are prevented are those classed as *unpreventable* previously and bears out the truth of the motto which is posted at the Brown & Sharpe works. *That problem that has to be solved always gets solved.*

Apprenticeship courses have been established by the Giddings & Lewis Machine Tool Co., Fond du lac, Wis., in its foundry and heat treating departments. The foundry course covers three years and the heat treating four years.

FIG. 4—AISLES ARE FOR TRAFFIC NOT FOR PARKING. FLOOR LINES KEEP STORAGE MATERIALS WITHIN PROPER LIMITS

New Company Formed To Run Foundry

Hoosick Foundries, Inc., Hoosick Falls, N. Y., has been formed to operate the recently acquired malleable and gray iron foundries and machine shops of the Walter A. Wood Mowing & Reaping Machine Co. Hoosick Foundries, Inc., is an outgrowth of the Hoosick Malleable Iron Works, formed in 1880. Officers of the company are: President, Henry Burden of Cazenovia, N. Y.; vice president and general manager, F. H. Fowler; secretary and treasurer, William C. Feathers. Directors are Mr. Burden, Mr. Feathers, first vice president of the Manufacturers National Bank of Troy; Charles W. Marvin, assistant vice president of the Guaranty Trust Co., New York; Frank L. Hilton, vice president of Bank of Manhattan, New York, and William H. Warren, Troy. E. K. McLean, Jr., is sales manager, E. P. Royal, office manager, George V. Usher, purchasing agent; Theodore Lang, superintendent of the malleable foundry; G. N. Allen, works manager.

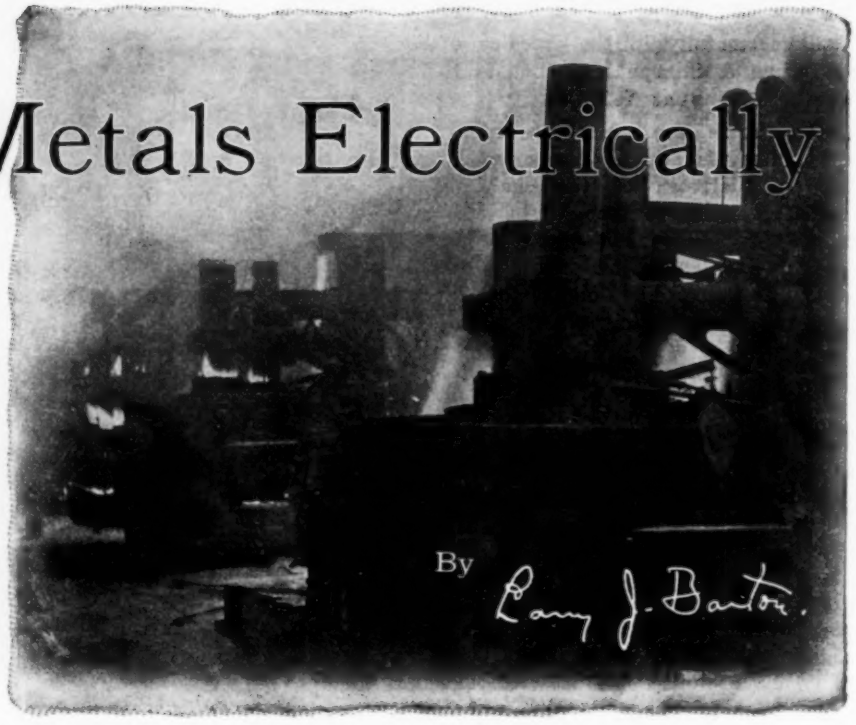
Appointed Manager

Robert Miller has been appointed manager of the Rocky Mountain sales district of the General Electric Co., Schenectady, N. Y., succeeding Harry D. Randall who is on leave of absence because of ill health. B. J. Wheatlake succeeds Mr. Miller as local office manager at Salt Lake City, Utah, and Mr. Randall has been assigned to special duties at the general office of the company in Schenectady. Mr. Miller's headquarters will be in Denver.

Refining Metals Electrically

Chapter VII (Concluded)

Controlling White Iron Structure—Alloying Gray Cast Iron



THAT the presence of chromium in remelted heats often resulted in poor results was known, since this point was shown by the writings of an Austrian author covering the manufacture of gun steel from remelted stock. He noted that chromium often, from no apparent reason, resulted in steels of a crystalline character, when one of fibrous structure was desired. This often was attributed to the presence of oxides, but his experiments demonstrated that it was not oxides, but the chromium that exerted some peculiar influence. The exact cause or the exact solution of this peculiarity never was discovered.

The author's results were similar, even though on iron. Heats made from remelted white iron which contained no chromium gave good results when the chromium was added as an alloy, but as soon as this chrome iron was remelted trouble ensued. This appeared periodically and as it was absolutely necessary to use this metal, a serious matter was presented. Many trials were made to obtain the solution of this trouble. Heats were melted with slags, and without slags. Carbon was added with the charge after the melt down. The heats were melted as fast as possible, and slowly melted. Heats were melted under perfect reducing conditions, and others were melted and heavily boiled with green poles. In fact every known metallurgical trick was tried, but with no success. The fact remained that if a heat gave the soft fracture, it could not be poured into heavy duty work.

This problem never was solved, the heats being so arranged that if a radical fracture was obtained, the iron was poured into high test work, otherwise a grade of standard white iron castings was poured. As these heats occured only about one in ten, the shop scrap was segregated carefully until sufficient was on hand for a heat, when it would be melted and poured into castings which did not require the resistance to shock property to a high degree. As this iron still retained all of its qualities except toughness there were a great many types of casting for which it proved excellent. All such work as ball mill liners, balls, etc., was poured from an iron made directly from the steel, so that no difficulty was encountered in maintaining the high shop standard.

Pouring Practice

WHEN the heat is poured into the ladle, a skim gate always should be used, and the ladle held at least 5 minutes before a mold is poured, that any included slag, coke or other non-metallic impurities may clear themselves from the metal by rising to the surface. The writer has found that about 5 pounds of finely crushed fluorspar added to the bottom of the ladle before the furnace is tapped aids this operation by combining with any slag, and so lowering its melting point that its fluidity is increased and it clears itself from the iron quickly.

Final deoxidizers such as titanium, magnesium, calcium compounds, etc., have been tried, but do not seem to add anything worth while. The use of vanadium, uranium, and zirconium has been suggested, but never have been tried.

Ladle troubles with this heavy basic slag will be the same as for gray iron, requiring the use of bottom pour, tea-spout or other system of ladles where the slag may be separated from the metal.

The size of the pouring gates and heads may be much smaller than is customary for cupola iron, due to the extra fluidity caused by higher pouring temperatures. A higher grade of refractory sand for molds and cores is necessary for the same reason. The high shrinkage of this iron necessitates great care in the molding to prevent undue cracking. Immediately on pouring, quick work must be done to relieve any strain in a casting by digging around the heads, loosening the copes, etc. The use of wood filler blocks, rope wrapped cores, coke and sawdust inserts, etc., finds wide favor in keeping the percentage of losses down. For small

Alloying Gray Iron

SUCCESS has attended the efforts of metallurgists to make superior steel products by the admixture of alloying elements. This has encouraged research along similar lines in recent investigations of electric furnace gray iron. Without this melting medium, success would be impossible, since some of the added metals produce conditions that require superheating. The metallurgy of gray iron stands on the threshold of valuable discoveries due to the investigation of the effect of carbon, heat treatment of white irons, casting in preheated molds and finally the appreciation of the importance of alloy additions. In this article, Mr. Barton outlines his experience with different metal additions in making white and gray iron in the electric furnace.

work the buzzer or automatic skim gate finds wide application.

Castings should be allowed to cool in the sand as far as possible, and under no condition should a casting be taken from the mold and quickly cooled, either in a draft of air or in water. If such a treatment does not directly crack the casting it is sure to set up internal strains of such magnitude that the piece later will fail in service, possibly with disastrous results. In the design of patterns, sharp corners should be avoided as far as possible, as these angles are starting points for cracking. Often on certain classes of work where square holes are essential, as in certain ball mill liners where a square headed bolt hole is used for rigidity, a further treatment is given to relieve the strain.

Relieve Strains

The treatment is similar to that followed in annealing steel castings, but is not intended in any manner to change the grain structure, and has no effect on the hardness of the metal. The castings are heated to approximately 500 degrees Fahr, and allowed to soak until the heat is uniform through the piece, when slow cooling is followed. Such treatment aids the strength of the work and castings so treated have shown extraordinary features of toughness, and resistance to shock, especially when the generally brittle character of this metal is considered.

Alloying Gray Irons

ALLOYS are used in producing quality gray iron mixes for the electric furnace. The greatest impetus to the use of alloys in gray irons was imparted by the discovery and commercial manufacture and sale of a natural alloy pig iron, placed on the market by the Bethlehem Steel Corp. coming from the province in Cuba where this natural alloyed ore is mined. This ore and the resultant pig contain chromium and nickel, always occuring in a certain ratio. Its use when developed and tried gave certain interesting features to the casting so made. It was found that iron castings made with this pig were soft, and readily machinable, yet at the same time were of a close grain with high strength. The iron found extensive use in hydraulic castings where a high strength iron with a close, tight structure was desired to resist the flow of liquids at high pressures through the walls. The results have been so good that its use has extended to a large number of such castings, one great class being automobile cylinder blocks.

The high character of the results obtained with this metal led others to make extensive experiments with various alloys to determine if there were any exceptional properties to be obtained from their use. Of these alloying metals, nickel probably has been tried more than any other metal. Its action in steel being well known it was expected that similar properties might be found when used in iron. While the results were different, it was found that the use of nickel was helpful, especially in certain classes of work. When used in gray iron nickel offers certain unique properties:

Nickel has the faculty of softening the metal even in the presence of high percentages of combined carbon, results having been given where an iron with 1.25 per cent combined carbon, containing approximately 4.00 per cent nickel, was capable of being cut easily.

Its influence seems to be identical with silicon as far as its ability to soften the iron extends, yet it accomplishes its purpose with no decrease in the strength of the iron, a point directly opposite to that of silicon.

It tends to close the grain of the iron, giving higher strengths at no expense to the machine shop in more difficult machining.

Nickel has the property of throwing carbon out of solution rapidly during the solidification, a point which makes this metal desirable in extremely thin walled castings, as it avoids any tendency toward chilling during the cooling period, which would cause the iron to become white.

Thin section castings containing from 3 to 4 per cent nickel may be bent and twisted to a certain degree

TABLE LXII

Heat Log of Alloyed White Iron

The charge consisted of 4000 pounds of clean borings and turnings, analyzing approximately: carbon 0.30 per cent; manganese, 0.50 per cent; silicon, 0.04 per cent. The analysis desired was: Carbon, 3.00 to 3.50 per cent; manganese 0.70 to 0.90 per cent; silicon, 0.70 to 0.90 per cent; chromium, 0.60 to 0.80 per cent. A radical structure was sought.

The final analysis of iron was: Carbon, 3.54 per cent; manganese, 0.87 per cent; silicon, 0.79 per cent; chromium, 0.65 per cent; phosphorus, 0.061 per cent; sulphur, 0.023 per cent.

About 1000 pounds of borings was charged on the hearth, followed by 240 pounds of 4 mesh coke, and a ground mixture containing 80 pounds lime and 20 pounds fluorspar. The remainder of the metal was charged and the doors sealed with a heavy clay mud.

8:00 a. m.

Current on. Contact poor at the start, and the load drawn by the furnace was low.

8:30

Load picking up as metal melts and forms better contact. Black fumes are emitted from around the electrode cooling rings due to the large amount of coke present.

8:45

Load steady, due to the metal having formed a good slag covered pool. The slag is holding the arc from surging.

9:30

Scrap has been going in fast, as told by the manner in which the furnace has been growling, and the heighth to which the electrodes have raised. Dense reducing flames coming up around the electrodes.

9:40

Door opened and a small amount of scrap hanging on the banks shoved in. Slag test coming from the furnace on the poke bar gives a heavy acetylene odor reducing when water quenched into a dark green powder. Slag a little heavy, and 20 pounds fluorspar added together with 2 shovels of anthracite coal.

9:45

Heat all melted. Metal test taken and poured into a sand mold, on end. Metal fairly hot, running clean from the spoon. Slag still too cold to foam, furnace again sealed.

10:00

Previous metal test now is black in the mold. Water cooled and broken, fracture estimated at close to 3.25 per cent carbon, the crystalline structure being well defined, but blow holes are prevalent around the rim of the test. Sent to chemist for carbon check. Another metal and slag test taken, the metal is hot and pours clean from the spoon. Slag strongly carbide, powdering dark grey and medium fluid. Given 20 pounds spar and 2 shovels anthracite coal. Vigorously boiled for 5 minutes with greed wood poles.

10:20

Chemist reports carbon at 3.32 per cent and manganese at 0.30 per cent. Second metal test taken now broken and shows carbon approximately 10 points higher, with no evidence of gas pockets. Structure assuming distinct radical appearance; 23 pounds ferromanganese and 36 pounds of ferrosilicon added.

10:30

36 pounds ferrosilicon and 53 pounds of ferrochromium added. Bath given a heavy rabbling.

10:35

Metal test taken. Temperature high, metal giving off sharp blue flames when poured from the spoon, and having the blue appearance of hot steel. Slag foaming slightly and heavy in its carbide character.

10:45

Final metal test shows a distinct star fracture, the crystal being clearly defined, of fairly large size, with a dead, steel grey color, having absolutely no trace of gas holes or porousness. Top of test bar has the wrinkled appearance of absolute freedom of any dissolved or included gas.

Heat tapped. Metal held in ladle 10 minutes before pouring the first mold.

The total time for heat was 2 hours, 45 minutes and the current consumption was 640 kilowatt-hours per ton of charge.

Test balls broke on 55, 52 and 58 blows Brinell hardness number was 432.

taking a permanent set upon releasing the pressure.

By far the best results on metal with nickel additions are obtained through the use of the basic process, in that low sulphur content and thorough deoxidation are possible. As this metal usually is cast into a high priced product, a few dollars difference in the cost of conversion is negligible when considered in the light of the high quality desired. The ordinary charge consists of pig nickel together with pig iron or high grade iron scrap. In mixtures where low phosphorus is desired, the greater proportion of the charge will be a low phosphorus pig iron. Best results are obtained when melting under a carbide slag from the start of the heat, consequently lime is added to the furnace with the charge, together with a small amount of carbonaceous material to furnish the necessary reducing atmosphere.

After the heat has melted a certain peculiarity will be noted. This found only in these nickel mixtures. A heavy separation of graphite from the metal is encountered as soon as the metal is thoroughly fluid. This resembles the separation of *kish* in blast furnace irons, but offers no difficulties, for as soon as the metal has been superheated this carbon rapidly returns to the iron, being soluble at high temperatures. As soon as this graphite deposition occurs, the doors should be sealed tightly and the furnace run for at least 15 minutes when a quick examination will disclose whether or not the re-solution has occured. If not more time is required.

There is no opportunity for close chemical analysis on such heats. Therefore great care must be exercised in the selection of the charge and furnace tests must be taken in a different manner. The spoon test is used to determine the temperature, but the metal instead of being poured into a square bar is poured into one of a wedge shape, capable of being split when black. This gives the fracture of the metal, and the amount of chill obtained in different sectioned castings. Knowing the desired structure of the metal for a certain class of work, it becomes easy to change the metal so that its character is that desired for any given section. This is done rapidly, either by the addition of small amounts of silicon, if the iron shows too hard, or by adding small proportions of steel for the softer fractures.

With the high percentage of nickel used, this iron has a higher melting point than its comparative nickel free mixtures and requires higher pouring temperatures. The electric furnace offers perfect conditions to attain this end. These alloyed heats are poured at temperatures close to those for steel, usually being tapped 2800 to 2900 degrees Fahr., which is extremely high for iron.

Tests Nickel Irons

In *Stahl und Eisen* of Sept. 30, 1920 some figures appeared covering results when nickel and cobalt were used in mixtures of gray iron. The authors used lower percentages than those mentioned in this section, namely from 1.00 to 1.50 per cent nickel. They state that they find 1.00 per cent nickel increases the bending strength approximately 30 per cent, the compressive strength, 30 per cent and the tensile strength, 18 per cent.

The use of cobalt was attempted, 1.00 and 2.00 per cent of the alloy being used. Results obtained were directly opposite to those obtained from nickel, the hardness increasing rapidly while the bending strength, the compressive strength and the tensile strength decreased. Therefore, the results were negative conclusively showing that cobalt does not offer any possibilities in its use for gray iron.

Moldenke at the Columbus meeting of the American Foundrymen's association, in 1920 gives some data covering the use of zirconium. It was found that its use was negative unless high temperatures of the iron were obtainable, the alloy seeming to require a high temperature to start its de-oxidizing reaction. When used in small percentages, in the form of 30 per cent ferroalloy, the results were fair, but larger percentages seemed to chill the iron so that results were negative. He gives some figures as follows:

Gray Iron Mixture

60 per cent pig iron, 40 per cent scrap. Averages from 3 bars each.

Breaking strength, lbs.	Deflection, inch	Zirconium added, per cent
2700	0.10	none
2920	0.11	0.05
2900	0.11	0.10
3050	0.11	0.15

White Iron Mixture

60 per cent car wheels, 40 per cent white iron scrap. 3 bars.

Breaking strength, lbs.	Deflection, inch	Zirconium added, per cent
2640	0.10	none
2790	0.10	0.05
2880	0.11	0.10
2940	0.11	0.15

From these figures it can be seen that zirconium offers nothing startling. With the higher temperatures obtainable in the electric furnace it might be possible to obtain more advantages by using larger percentages of alloy, a point which later research may prove.

Molybdenum is finding considerable use in iron castings of late years, especially in chilled rolls. Rolls for mill work are important in that as accurate check is kept upon the service given throughout the life of the roll. The roll which gives a longer period of active service naturally is the one which will be in greatest demand. Roll makers faced with such a proposition have turned to the use of any alloy which would give a superior product. The use of the molybdenum is a result of this research.

This element finds its greatest asset in its accurate control of the depth of chill. It seems that its use promotes a more active metal, one which is sensitive to the effect of a chill. This results in the possibility of being able to make rolls in which this desired chill may be controlled to an exactitude not possible with the ordinary and more sluggish mixtures. As the depth and character of the chill on a roll is the most important point in manufacture, molybdenum seems to have been a great aid. This also has been used to some extent in car wheel manufacture, but no definite information is available as to the results obtained.

In the ordinary grades of iron castings molybdenum does not seem to confer any added properties to the metal, and its use has been limited.

Vanadium has been used in iron mixtures, and confers certain helpful properties. Its main asset is in slightly closing the grain of the metal and in throwing out the graphite in finer and smaller flakes. This gives a soft, and readily machinable iron which may be used where high speed production is necessary. Whether these properties can be obtained at a cost commensurate with their importance is yet undecided.

Cerium, uranium, titanium, etc., all have been used at various times in gray iron castings, but their use has been experimental, the result being of such a character that no further attention has been paid to their commercial use.

Receives Apparatus

Sir William Bragg, Faraday laboratory, Royal Institute of Great Britain has been presented with an X-ray diffraction instrument by General Electric Co., Schenectady, N. Y. This instrument, developed by General Electric scientists, makes use of powdered material to study crystal structure.

Bill Hands Out Advice on Brake Shoes

BY PAT DWYER

EVERY year about this time Bill and I join a party of carefree and—more or less—young fellows to spend an elegant day in the peace and quietness of the country about two hour's drive from the heat and dust and mad turmoil of the city. Every year we plan to start right on the dot from a given point at 8 o'clock and every year we manage to get away at about the same time, 9:30. In some unaccountable manner one member always succeeds in holding up the procession. In strict justice it must be admitted that this is not always the same person. Therefore, up to the present no satisfactory plan has been developed to cope with the situation. Obviously it would be the height of folly on the part of any person to assume the role of judge and jury one year when according to the ordinary law of averages he might find himself playing the part of the delinquent the following year. As a result all those who arrive at the rendezvous on time sit around and stew. The more charitably inclined wonder what is the cause of the delay. The others express the most fervent wish that the missing member either has been rammed by a truck or has been pinched for speeding and sent up for a sufficiently lengthy period to enable him to appreciate the peace and advantage of the quiet life. The present expedition differed in no respect from the others. We waited at the appointed place until 9:30 and then with one unit of the train missing, the caravan of covered wagons got under way. Fortunately the trail was wide and open and conveniently paved with either brick or concrete all the way. Owing to this favorable condition we made considerably better time than the original settlers of the Western Reserve who did their traveling over the rolling and forest covered territory through which we passed. The further fact that the old plodding ox teams were replaced by the synthetic energy of 60 or 90 horses undoubtedly must be reckoned as a contributory factor in our favor. Without exception the drivers were men of skill and experience and brought the caravan safely to the appointed camping place without the loss of a single passenger or a drop of treasure. Incidentally it may be of interest to note that the missing wagon arrived half an hour later with everything intact including an alibi which no one believed.

In company with about 30 other daring pioneers from the settlements of Cleveland, Pittsburgh and points in other less thickly settled parts of this wild western country we passed the time pleasantly for several hours while the high priest and his assistants prepared the big medicine for the concluding ceremony.

For several years members of the friendly tribe which inhabits the valley have been accustomed on stated occasions to offer a sacrifice to the great God Moloch. They implicitly believe that their material well being, comfort and prosperity depend on the observance of this rite. They have sufficient faith to move mountains, but they also go a step further. Bearing in mind St. Paul's pertinent comment that faith without good works is on the blink or words to that effect, they work like beavers after the mountain has been moved.

They blow down the whole face of a cliff made up of conglomerate quartz that runs about 99 per cent silica. The broken rock is transported to an elaborate plant where it is crushed, disintegrated and screened and then thriftily disposed of to foundries for molds in which to make steel castings, for sandblasting, for filtering purposes, for road building, for making concrete and other uses over a territory within a radius of 500 miles.

For several weeks before our arrival a gang of men had been engaged in drilling a row of 70 holes, 10 feet apart, 10 feet back from the face of the cliff and 65 feet deep. These holes were filled with explosive, connected by a long fuse that terminated at a safe distance. Almost 9 tons of explosives were packed in the holes and at a given signal were touched off simultaneously. I have read of many sacrifices, big ones and little ones, old and new offered under many conditions and for many purposes, but outside of a wholesale cataclysm of nature, never have I heard or read of one that approached this one in awe inspiring grandeur and dignity. Following a dull boom, a tremor of the earth on which we stood and a cloud

ABSENT TREATMENT FOR WOTTLE-I-DOO

of smoke, the whole face of the cliff for a distance of 700 feet and estimated at 45,000 tons sprang away from its anchorage of centuries and slowly collapsed in a mass of debris on the floor of the quarry. The big chief threw a practised eye over the conglomeration, estimating what further minor blasting would be required to reduce some of the big boulders to a size that could be handled by the powerful electrically operated shovel and nonchalantly admitted that it was a good shot. During the day the company mixed promiscuously, but I noticed that Bill hobnobbed most of the time with one man. On the way home he confided to me that this lad was a steel foundry superintendent, a man of parts who had enjoyed an extended experience in many parts of the country. To Bill's extreme gratification he learned they had many mutual acquaintances and naturally the conversation flowed along in easy channels.

THE LAD THREW A WICKED CURVE

In discussing the trials and tribulations of the foundry superintendent they met on congenial ground and exchanged many interesting experiences. Bill's friend deplored the fact that competent assistants are so hard to secure. The average molder advanced to the position of foreman will not assume responsibility. He has a constitutional dislike to making decisions and pesters the life out of his immediate superior to settle points of minor importance. He takes the attitude that the boss is paid for that kind of work, conveniently ignoring the fact that he was appointed primarily to relieve the boss of a mass of irritating detail.

"To illustrate the point," said Bill. "He told me of a night foreman he had one time. This lad called up the master mechanic one night about 1 o'clock to tell him that the scrap shears had broken. He asked him what he should do. The master mechanic had his own ideas about being called out of bed in the middle of the night to answer conundrums. 'Do?' says he 'I'll tell you what to do. You know where the canal is? Well, you take that triple distilled son of a missbegotten shears down to the canal and throw it in. Then tie a good big lump of a rock around that part of your body which supports the empty shell you think is your head and jump in after the shears. Good night!'

"I don't know," said Bill, "which is the more difficult type to get along with as an assistant. The easy going lad who is a good mechanic, who has a great respect for his immediate superior and who looks upon his elevation from the ranks as a species of reward for long service; or the up and coming snappy young fellow with a college diploma and the average young college man's contempt for any grade of knowledge not contained in his particular curriculum.

"The first man's shortcomings may be set down as sins of omission due to a trait in his character which never has been cultivated or developed. A species of mental laziness in some cases grows up and chokes the germ of originality, initiative and independence with which many boys are endowed and which shows in brief intermittent flashes on their first entry into industrial life. In a short time they learn to adapt themselves to the job so that they may get by with a minimum of effort, either mental or muscular. They follow the path of least resistance and take a smooth and complacent pride in being referred to as good mechanics and steady, faithful workmen. They never are late, never absent and so long as they remain on the floor they are a source of comfort and consolation to the superintendent.

"If he figures on putting a certain job in the sand on a given day and if he anticipates a maximum production in a stated time, he need have no misgivings on either score. Old Jacob Faithful will be on hand that day and the job will be run up to the peak either on time or a little under the time. Trouble does not commence until Jacob is taken from the floor, given a roving commission and given to understand that in future he is expected to use his head instead of his hands. A head that never has been exercised becomes just as rusty as any other member. Perhaps a more appropriate description would be to say the head grows flabby like any muscle for want of use. It is easier for the average person to dodge responsibility and to lean on some other person than it is to stand on his own feet and see that the discipline and policy of the shop are carried out strictly according to program. While this type of man causes trouble through sins of omission it is an open question whether he is quite as objectionable as the second type who keeps the shop in a continual uproar through sins of commission. With little or no actual experience on which to base an opinion he throws out orders, makes decisions and suggests improvements along lines that actually are impossible of fulfillment through physical or other limitations. Occasionally he consults his superintendent before attempting to put some policy in force, but usually he dispenses with the formality. He is so sure of the merits of any idea originating in his own mind that he cannot imagine any person objecting to it. Sometimes he is so overwhelmed with the importance and possibilities of an inspiration, that he forgets the presence of every officer in the organization and insists on a personal interview with the president. His idea of perfect efficiency is to keep the entire force working at top speed, irrespective of whether the efforts of various individuals or departments, synchronize or not.

"I had occasion to check up on one of these dynamic young gentlemen one day while he was supervising the pouring of a ladle of steel. The metal was not hot enough and I told him he should not have attempted to pour the castings with it. 'What nonsense,' said he, 'I had no alternative. I had no large molds on the floor. No. 2 furnace is almost ready to tap and I have to empty the ladle to release the crane!'

"This particular young lad was a graduate mechanical engineer and paid particular attention to the upkeep and operation of the mechanical equipment of the foundry. He had prepared an elaborate series of charts including one for each of the cranes. Starting at zero every morning one line recorded the current consumption from hour to hour. A second line presented graphically the total weight lifted in the same time. The time spent in moving light from one point to another was shown by a third line. A heavy red line indicated periods of

idleness for any cause and so long as he could keep the cranes moving he was happy. Spoiling a floor of molds by pouring them with cold metal meant nothing in his young life. The crane was kept busy for nearly an hour and the efficiency curve was not marred by an unsightly red line. The cold metal was an error properly chargeable against the melter's record.

"He spent about two hours every morning with a slide rule plotting his various curves and working out his position like a deep sea navigator with a table of logarithms. The exercise did him or no one else any harm. In fact I considered the time well spent and even encouraged him to pursue his investigation to greater length. While he was busy in the office I knew he was not prowling around the shop engaged in his favorite occupation of slipping figurative monkey wrenches into the gears."

"It seems to me," I said at this point, "That you carried the spirit of toleration too far. Why didn't you fire him and get some person who would be some use to you?"

"Ah!" said Bill. "There speaks the innocent little babe in the wood. Had I been free to exercise my own sweet will nothing would have given me greater pleasure than to have placed that charming young man in the Great Gun of Athlone and fired him at least half way to Timbuctoo. However, I was only an humble cog in the wheel with a wife and family depending on my modest monthly stipend to stave off the combined attacks of the butcher, the baker and candlestick maker. The young man was the son of the president of the company, nobly commencing at the bottom of the ladder as assistant superintendent. Need I say more? No, says you in ringing tones, you need not."

"Talking about presidents and all that kind of thing," said Bill, "Reminds me of a letter I had the other day from the president of a foundry company in South America. He was considering the advisability of making brakeshoes and at the suggestion of one of his molders, an American by the name of Frank McCarthy, he was writing me for some information on the subject. That was the first news I had of Frank for several years. The last time I saw him was when he waved his hand to me from the stern of an old British tramp pulling out of Newport News. Believe me he was some kid. I remember one time—Oh, well that is another story I'll tell you some time. One thing at a time. That's me. Here's a copy of the letter and my reply. You can read it for yourself while I try to keep this old cripple on the road."

Dear Sir: At the suggestion of one of my men, Frank McCarthy, who claims acquaintance with you I am writing for any information you can give me that may be of service in the manufacture of box car brakeshoes in this country. The castings are somewhat similar to those made in the United States. What are the railroad and government specifications covering analysis, insertions, mode of testing and heat treatment, if any. Other specific details on which I shall appreciate your advice include, the most suitable molding machine for making these castings, average days work and wages for a molder, which side of the shoe is formed in the lower part of the mold, how the inserts are held in place and any other items which you think might be of service to me.

Bill's reply read as follows:

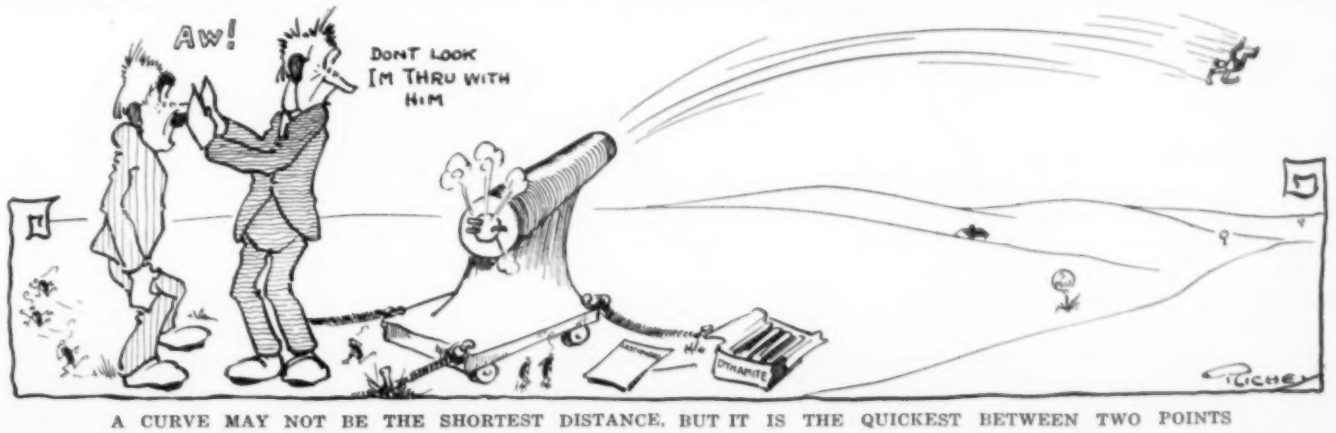
Brakeshoes are made in many shapes and sizes for service on locomotives and cars. The locomotive brake shoes are divided into two classes, those on the drivers and those on the wheels under the tender. Car wheel brakeshoes also are divided into two general classes, those to be used under passenger coaches and those used in connection with the operation of freight cars. Since you are only interested in the last class our reply to your inquiry will be confined to a brief description of the manufacturing methods employed on these castings.

The molds are made wearing face down in small iron flasks from a pair of patterns mounted on two machines one for the copes and one for the drags. The drag patterns are attached to a bar actuated by a lever at the side of the machine and are dropped through a stripping plate before the drag flask is removed from the machine. The pattern on the cope machine is a plain plate with the contour of the upper side of the castings integral with the face. The cope flask is lifted directly from the machine and placed on the drag. The eye by which the brakeshoe is suspended over the wheel is formed by a small core rammed up in the cope. Practically all American molding machine manufacturers have developed machines suitable for making these castings.

The American Brakeshoe & Foundry Co., control several patents relating to the use of inserts in brakeshoes and it might be advisable for you to familiarize yourself with the company's rights in this respect before engaging in the manufacture of these castings. Many shoes are made without inserts. They are poured from a mixture of the following analysis: Silicon 1.40 to 1.60 per cent, sulphur 0.08 to 0.10 per cent, phosphorus under 0.50 per cent and manganese 0.50 to 0.70 per cent. The total carbon will be low. The castings are not heat treated. An inspector representing the customer is present in the foundry and examines test blocks poured in his presence. The test piece is poured against a chill on one side and when it is broken must show a chill of a definite depth.

Brakeshoes are subjected to two forms of test to meet the Master Car Builders standard. One is to determine the coefficient of friction and the other is to test the wear. Shoes shall develop upon the cast iron wheel in effecting stops from an initial speed of 40 miles per hour, a mean coefficient of friction of not less than (a) 22 per cent when the brakeshoe pressure is 2808 pounds and (b) 16 per cent when the brakeshoe pressure is 6840 pounds.

Shoe wear shall be determined upon the cast iron wheel by making not less than 100 applications of the shoe to the wheel under pressure of 2808 pounds and at a constant peripheral speed of the wheel of 20 miles per hour. At each application the shoe shall remain in contact with the wheel during 190 revolutions of the latter and between applications the shoe shall remain out of contact during 610 revolutions of the wheel. Under these conditions the shoe shall lose in weight not more than 0.8 of a pound for each 100,000,000 foot-pounds of work done.



A CURVE MAY NOT BE THE SHORTEST DISTANCE, BUT IT IS THE QUICKEST BETWEEN TWO POINTS

Study Peeling in Malleables

Phenomenon Is a Defect Well Known to Malleable Foundrymen and Machinists, Being Found Frequently in Manufacture and Use of Malleable Cast Iron

By Douglas H. Ingall and H. Field

CASTINGS suffering from peeling defect present a normal outward appearance, but the fracture after breaking reveals an inner core, surrounded by one or more layers of *skin* or *peel*, these layers being so loosely attached to the core and to one another that either they become detached in the breaking or may be removed by a few blows with a hammer. The remaining core then presents a smooth surface, and generally has the same contour as the original specimen.

The mechanical properties of the metal are not affected greatly by the presence of this internal defect, except in cases where it may be pronounced, such as in thin plates, where the core may be entirely absent and the metal only a series of *skins*. In breaking tensile test-bars or in bending tests it is noticed that both skin and core elongate together for a time, after which the skin begins to crack and part from the core. The trouble with *peeled* castings arises when they are machined, as either in planing or screwing the entire skin may come away from the core, or in milder cases the threads peel off as a string. Smaller castings which are not machined are often water-barrelled before plating, and this prolonged process sometimes wears right through the outer skin at one place and the whole then peels off.

One of the authors, engaged in the production of malleable castings, frequently came across such defective castings, and an attempt was made to locate the faulty procedure involved, although no formula was found which satisfies every case. It became apparent that the question was one for systematic research, and the method chosen as explained later, has been to reproduce the phenomenon under known conditions.

ALTHOUGH recognized as a defect frequently occurring in white heart malleable castings, little has been written and no agreement has been reached as to the cause of the layers of skin or peel which are attached loosely to a center or core. The authors have described the results of a series of tests to determine the cause of this trouble. Mr. Ingall is head of the County Technical college, Wednesbury, England, and Mr. Field is connected with J. Harper & Co., Ltd., Willenhall. The paper was presented before the annual meeting of the Iron & Steel Institute, London, England, May 8.

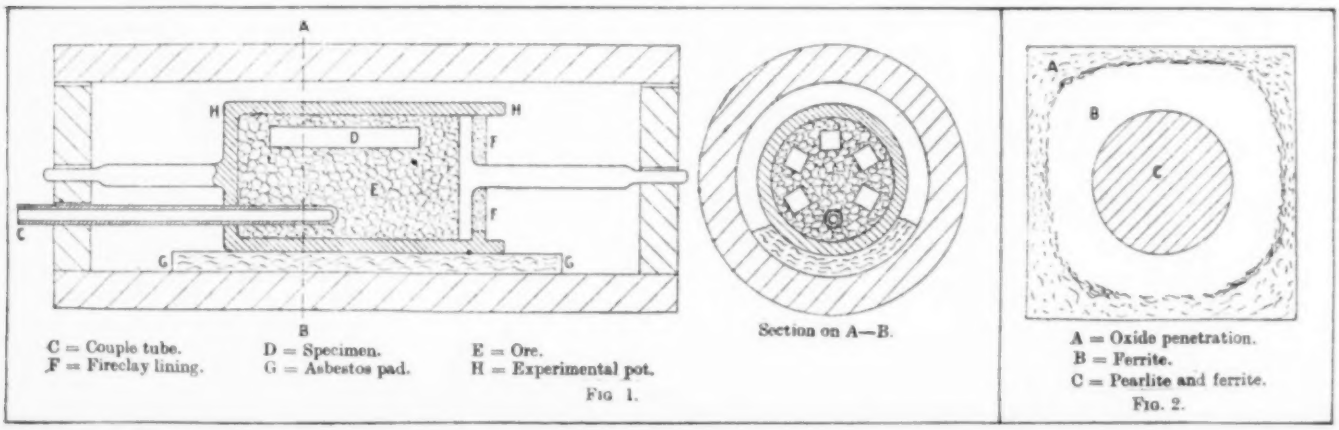
Cause Of Peeling

In practice it has been found that the trouble may be attributed to a large number of causes. At different times it has been attributed to variation in almost any and every part of the process. References in published work are scanty, and so far as the authors are aware there are none in any of the foundry textbooks. In the discussion of a paper by Hurren, at a meeting of the Institute of British Foundrymen, various speakers referred to peeling as due to the furnace having its temperature raised too quickly; high manganese content; high sulphur content; too high annealing temperature; and too strong annealing ore.

W. H. Poole describes the phenomenon carefully, and formulates a theory, as also does J. W. Gardom, both of these writers attributing the defect to a rate of carbon elimination at the surface more rapid than that of the diffusion of carbon within the casting.

From the known irregularity of the occurrence of peeling in works practice, and in view of the divergent and sometimes conflicting opinions expressed on the phenomenon, it was obvious that the investigations should cover a wide field. The possible controlling influences appeared to be capable of classification, under the following main headings: Chemical composition of the cast iron; structure of the cast iron; temperature of annealing; time of annealing; rate of heating to annealing temperature; and nature of the annealing ore.

The experimental work was developed to investigate these influences under known conditions, but at the same time every endeavor was made to make the known conditions such



C = Couple tube. F = Fireclay lining. D = Specimen. G = Asbestos pad. E = Ore. H = Experimental pot.

FIG. 1.

A = Oxide penetration. B = Ferrite. C = Pearlite and ferrite.

FIG. 2.

FIG. 1—DIAGRAMMATIC SKETCH OF SECTION THROUGH ANNEALING FURNACE. FIG. 2—CROSS SECTION OF MALLEABLE CASTING SHOWING PEEL STRUCTURE

that they could be directly comparable with works practice.

Fig. 1 shows a diagrammatic sketch of a section through the annealing furnace, which was a horizontal electric resistance tube furnace, the silica tube being 4¾ inches inside diameter and 18 inches long. The tube was closed at each end with firebrick non-heated plugs 2 inches thick.

The annealing pots were made of ordinary white cast iron of the kind known as pot metal. Each pot was of cylindrical form, having an inside diameter of 4 inches and a length of 6 inches. As shown in Fig. 1, a lug was cast on one end of each box and also on the lid to help support the box in the furnace. A hole also was cast at the end of each box, at a radius to which the specimens were inserted, to take a nickel-chromium tube containing the thermocouple. This tube was wedged into position with asbestos paper, and the sealing of the iron with each experiment was sufficient to seal it in. After the lid was placed in position, it was luted up with fireclay.

All the specimens were cast in green sand under works conditions to dimensions 3½ inches by ⅜-inch square. Bars Nos. 1, 2, 4, 5, 6 and 7 were cast from a crucible, each being from a different brand of pig iron. Nos. 3 and 8 are ordinary cupola melted cast iron for malleable work, containing 25 per cent each of two pig irons and 50 per cent of foundry scrap. Series *A* to *E*, *F* to *H*, and *L* to *P*, each were made by melting virgin pig iron and adding iron sulphide in varying amounts to give a steady increase in sulphur. *CM* is a metal used for annealing pots for malleable work. The analyses of the specimens used are given in Table I, some figures being omitted in series cast from the same melt.

Table II

Effect of Sulphur on Peel

Specimen	Silicon			Sulphur		
	Outside	Second position	Center	Outside	Second position	Center
E1	0.378	0.360	0.377	0.218	0.48	0.520
E2	0.575	0.638	0.600	0.161	0.392	0.60
E3	0.550	0.518	0.540	0.084	0.535	0.79
E4	0.745	0.745	0.770	0.127	0.351	0.64
D5	0.74	0.74	0.755	0.139	0.198	0.172
D6	0.865	0.865	0.820	0.820	0.378	0.426
E6	0.90	0.795	0.80	0.128	0.530	0.70
E7	0.750	0.750	0.71	0.066	0.061	0.061

Annealing ore was taken from the stock in use at the malleable annealing ovens, consisting of four parts of used ore and one part of new red hematite ore, the whole being of 70 kibble mesh size. Temperature measurements were made by a platinum, platinum-rhodium couple inserted into the couple tube.

As no continuous recording instruments were available, the temperature records were made from frequent readings. It was found by observation that the fluctuations due to variations in the electric supply did not amount to more than plus or minus 12 degrees Cent., which was well within works practice.

To conform to works practice, the rate of heating, unless otherwise specified, was in each case about 30 hours to reach the required temperature, and about 30 hours to cool off.

Use Three Divisions

For descriptive purposes, the amounts of peeling obtained have been divided into three categories—slight, moderate and heavy. By slight is meant a thin flake with a thickness of the order of a piece of paper. Moderate is about half-way between the thickness of slight and that of heavy, the latter being approximately 1/16 inch. These sizes are merely intended to convey a rough idea as, naturally, many variations of thicknesses were obtained.

To test for *peeling*, the specimens were clamped firmly in a vise for 1-inch of their length, and gradually bent over with blows from a hammer until fracture occurred. The fractures were then examined for the separation of peel from core.

In experiment *A*, specimens of 1, 2, 3, 4, 5, 6 and 7, giving a wide range of composition, were packed in a box and annealed for 96 hours at a temperature of 950 degrees Cent.

The following were the results when tested for peeling:

A1. None	A2. Heavy	A3. Slight	A4. Slight
A5. Slight	A6. Heavy	A7. None	

All the samples were annealed fully, without any signs of hardness.

From the analyses it was seen that peeling was obtained with metal which exhibited no particular feature with regard to any one of its constituents. The specimen *A2* which had peeled most had an average analysis. It was decided to take sulphur prints of the specimens, longitudinal sections, and to examine them microscopically. At the same time, in view of the possible effect of original structure, it was decided to investigate the microstructure of specimens in the *as cast* condition.

All the microstructures of specimens 1, 2, 3, 4, 5, 6 and 7 in the cast condition showed the normal structure of white iron without any particular feature. Longitudinal sulphur prints of specimens *A1*, *A2*, *A3*, *A4*, *A5*, *A6* and *A7* showed that the peel, where it occurred, was comparatively free from sulphur; but sulphur segregation was found at the boundary between peel and core in patches in specimens *A2*, *A3*, *A5* and *A7*, and completely in specimens *A4* and *A6*.

In microstructures of specimens *A1*, *A2*, *A3*, *A4*, *A5*, *A6* and *A7* it was found that, broadly speaking, all specimens exhibited one general type of structure. As this type of structure was also found in all subsequent specimens which were microscopically investigated, and as it revealed the na-

Table I

Analysis of Test Specimens

Descriptive Mark of Specimen	Silicon	Sulphur	Phosphorus	Manganese	Total carbon	Combined carbon
1	0.427	0.56	0.035	0.09	2.90	nil
2	0.635	0.35	0.046	0.099	2.95	"
3	0.496	0.53	0.060	0.075	2.75	"
4	0.718	0.30	0.035	0.130	3.15	"
5	0.750	0.178	0.033	0.225	2.88	"
6	0.875	0.42	0.040	0.020	2.87	"
7	0.690	0.068	0.070	0.025	3.07	"
8	0.760	0.345	0.079	0.20	3.30	"
A	0.605	0.278	0.043	0.24	3.49	"
B	0.575	0.375	.....	0.23	.....	"
C	0.555	0.406	.....	0.20	.....	"
D	0.585	0.425	.....	0.20	.....	"
E	0.590	0.405	0.043	0.20	3.46	"
F	0.575	0.110	0.085	0.08	2.96	"
H	0.605	0.140	0.083	0.12	3.10	"
K	0.560	0.200	.....	.....	.....	"
L	0.550	0.046	0.086	0.140	3.48	"
M	0.520	0.138	.....	0.158	.....	"
N	0.520	0.210	.....	0.138	.....	"
P	0.520	0.083	.....	0.164	.....	"
CM	0.320	0.242	0.098	1.250	3.31	"

ture of the peel, it was thought that a somewhat detailed description of it would not be out of place.

A diagrammatic sketch of the structure is given in Fig. 2, which represents a cross section of a specimen. It is seen that the structure resolves itself into three main zones which, taken in order from the outside of the specimen to the center, are composed as follows: Zone 1—Highly oxidized metal containing free globules of oxide. Zone 2—Ferrite becoming more and more oxidized toward the border of zone 1. Zone 3—Pearlite and ferrite.

Zone 1 is that which forms the peel in a specimen. The extent and amount of peel is determined by the degree of penetration of this zone. At the boundary of this zone with the ferrite or zone 2 it generally was found that there was an accumulation of inclusion which was more or less continuous, and the boundary formed the cleavage plane along which the peel separated from the core. Sometimes it was found that zone 1 contained two or more of these accumulation boundaries, in which case the specimen would exhibit a number of peels corresponding with the number of boundaries. Freedom from peeling was found to be consistent with either absence of zone 1 or its presence to a limited and irregular extent.

Zone 2 calls for little comment. Its oxidized condition exists toward the boundary of zone 1. As would be expected, the grain-size of the ferrite was larger the higher the temperature of annealing.

The extent of the whole zone 3 and the relative proportion of pearlite in it varied, according to the decarburization. Generally the amount of carbon varied from a minimum at the border of zone 2 to a maximum at the center of the specimen. In the cases of incomplete annealing free cementite was found in the central portions. The relative widths and extents of the three zones were found to vary considerably, according to annealing conditions.

In experiment *B* specimens 1, 2, 3, 4, 5, 6 and 7 were annealed for four days, 96 hours, at 910 degrees Cent. The results with regard to peeling were as follows:

B1.	B2.	B3.	B4.
None	None	None	None
B5.	B6.	B7.	
Slight	Slight	None	

The lower temperature did not promote the production of peel, but the specimens were not thoroughly annealed. Specimens *B*1 and *B*3 had centers which were appreciably hard when cut through with a hack-saw.

The microstructures revealed the general type of structure in which zone 1 practically was absent or irregular, and in zone 3 areas containing more or less free cementite.

In experiment *C* specimens 1, 2, 3, 4, 5, 6 and 7 were annealed four days, 96 hours, at 1010 degrees Cent. The following were the peeling results:

C1.	C2.	C3.	C4.
None	Slight	None	Slight
C5.	C6.	C7.	
Slight	Slight	Slight	

The temperature of this experiment is probably above the maximum aimed at in good works practice, where 1000 degrees Cent. is generally looked upon as too high. The results indicate that a high temperature tends to suppress rather than accelerate the production of peel.

Table III

Amount of Peeling

Specimen	Experiment L.	Experiment M.	Experiment N.
1	Heavy	Heavy	Heavy
2	Slight	Slight	Heavy
3	Heavy	Heavy	Heavy
4	Slight	Slight	Slight
5	Slight	Slight	Slight
6	Slight	Slight	Moderate
7	Slight	Slight	Slight

All the specimens were quite soft, and the microstructures revealed the general structure, with usually a rather indefinite zone 1, a fairly wide zone 2, and a relatively small zone 3, with low average carbon content, containing in some cases small amounts of graphitic carbon.

As most peeling had been obtained at 950 degrees Cent., it was determined to prolong the time of annealing at that temperature. Specimens 1, 2, 3, 4, 5, 6 and 7 were annealed six days, 144 hours, at 950 degrees Cent. The following were the results obtained in regard to peeling:

D1.	D2.	D3.	D4.
Extra Heavy	Extra Heavy	Extra Heavy	Heavy
D5.	D6.	D7.	
Heavy	Moderate	None	

The results show at once that, under suitable conditions, the growth of peel progresses with time. As the results, especially in *D*1, *D*2 and *D*3, were so much more pronounced than anything obtained previously, it was thought desirable to repeat the conditions. This was done in experiment *E* which, with small variations, entirely confirmed the results of experiment *D*.

The microstructures were of the general type, giving on an average a comparatively large zone 1 and a small zone 3.

The authors yet were without evidence as to the influence, or influences, which start the peeling phenomenon. As, in the last two experiments, the extent of the peel reached in some cases to nearly half-way between the outside and center of the specimens, it was resolved to make analyses with regard to silicon and sulphur on sections of some of the specimens, obtained by milling off successively one-third of the whole specimen all round. The results obtained are shown in Table 2. These figures confirm the results of the sulphur prints to the extent of revealing a minimum sulphur content in the peel.

Similar analyses on reduced sections of the bars in the hard state showed that the silicon and sulphur in the original metal are distributed equally within macroscopic limits, and without segregation.

In experiment *F* one of the experimental pots charged with specimens 1, 2, 3, 4, 5, 6 and 7 was annealed on the top of a pile of pots in a works heat for six days. From the appearance of the specimens the conditions had been closely akin to experiment *C* and the results obtained were similar.

The variations of sulphur distribution as revealed in Table 2 pointed to the possible influence of sulphur content with regard to peeling. It was therefore determined to investigate specifically the effect of sulphur. In experiment *G* specimens *A*, *B*, *C*, *D*, *F*, *H*, *K*, 8 and *CM* were annealed five days, 120 hours, at 950 degrees Cent. The results obtained in regard to peeling were as follows:

GA.	GB.	GC.	GD.
Slight	Slight	Slight	Slight
GF.	GH.	GK.	G8.
None	None	None	Slight
CM.			
None			

Unfortunately the furnace broke down twice during the running of this experiment, and at one period it accidentally reached a temperature of 1000 degrees Cent. for a short time, so that a further test was made. This was the only experiment in which the high manganese bar *CM* was included, and this metal did not peel.

In experiment *H* specimens *A*, *B*,

C, D, L, M, N and *P* were annealed six days, 144 hours, at 950 degrees Cent. The following were the results in regard to peeling:

HA. Slight	HB. Slight	HC. Moderate	HD. None
HL. None	HM. None	HN. Moderate	HP. None

From a consideration of these results together with former ones, it would appear that both high and low sulphur contents are deterrents toward peeling which may most easily be produced within a range of sulphur content from approximately 0.2 to 0.4 per cent. The results also indicate that the higher the silicon content, the greater the tendency for the production of peel.

For experiment *J* an abnormal rate of heating was employed to give an extreme result. A temperature of 950 degrees Cent. was reached in seven hours and maintained for six days, 144 hours. Specimens 1, 2, 3, 5, 6, *B, D* and *N* were used. The following were the results in regard to peeling:

J1. Slight	J2. Heavy	J3. Heavy	J5. Moderate
J6. Heavy	JB. Moderately Heavy	JD. Moderately Heavy	JN. Slight

It was obvious that rapid heating was an important factor toward the production of peel.

In experiment *K* specimens 1, 2, 3, 6 and *N* were heated rapidly in seven hours to 950 degrees Cent. and maintained at that temperature for two days, 48 hours. The following were the results in regard to peeling:

K1. Slight	K2. Moderate	K3. Moderate	K6. Moderate
KN. Slight			

The results showed that the phenomenon of peeling, when present, commences with the annealing effect. The microstructures were consistent with the general type of structure, according to the conditions, and showed free cementite in zone 3.

To verify the experimental results obtained it was decided to carry out a test under ordinary works conditions. An oven running an ordinary works heat was arranged as follows: In experiment *M* a thin works pot was placed on the top of a tier in center of the oven, without the corresponding pots each side of it on the neighboring tiers, so as to expose it freely to the flame.

In experiment *N* a new pot was placed in a corresponding position in the oven, but with pots each side giving quite normal conditions.

In experiment *L*, experimental pot was placed on the top of pot *M* subjected to exposed condition. Specimens in each case were 1, 2, 3, 4, 5, 6 and 7.

The oven was fired more rapidly than usual, so that pot *N* reached its normal temperature of probably 950 degrees to 975 degrees Cent. at a slightly quicker rate. Pot *M* also was heated at a somewhat faster rate. By intermittent temperature determinations with patent heat-recorders, which indicated the temperature within a range of 15 degrees Cent., the temperature was found to vary between 970 and 1000 degrees Cent. Pot *L* was heated most rapidly, and probably had a temperature somewhat over 1000 degrees Cent. The heat lasted for six days, 144 hours. The results are given in Table III.

Promotes Effects

Experiments *L, M* and *N* confirm the conclusion that increased rate of heating promotes the development of peel, but that a high annealing temperature retards its growth. To confirm this deduction under drastic conditions the experiment *P* was carried out. Specimens 1, 2, 3, 4, 5, 6, 7 and *N* were heated to 1050 degrees Cent. in six hours, cooled to 1020 degrees Cent. and maintained for two days.

The following were the results in regard to peeling:

P1. Slight	P2. Slight	P3. Slight	P4. Slight
P5. Slight	P6. Moderate	P7. None	PN. None

The results confirm the previous deductions.

As all the above experiments were conducted with ore of normal composition, it was thought unnecessary to carry out experiments on variations in the composition of the ore.

The authors desire clearly to point out that the following conclusions are put forward in a broad and general way. At the same time, they feel that the work which has been outlined has laid a foundation with regard to the influences underlying the production of peeling in white-heart malleable, so that detailed conditions may be developed by subsequent research.

In the light of the above statement, the influences affecting the production of peel may be summarized as follows:

1. Metal containing sulphur between approximately 0.20 and 0.40 per cent will be liable to peeling, and the higher the silicon content the greater will be the liability.

2. Temperatures in the neighborhood of 950 degrees Cent. are most conducive to peeling. Higher and lower temperatures, though they do not necessarily prevent the formation of peel, retard its growth. With lower temperatures there is, of course, the risk of the material not being completely malleableized, and with higher temperatures the possibility of burnt metal resulting.

3. The faster the rate of heating to the annealing temperature, the greater by far is the liability to produce peeling.

4. The peel has been found to consist of a layer or layers of ferrite containing free oxide globules as inclusions. When this layer is once formed it will continue to grow with time, according to temperature conditions.

5. The work outlined above has not given any definite proof of the mechanism causing the development of peeling. With the evidence obtained the following view is tentatively put forward.

The formation of peel is the result of oxidation of the metal. There would appear to be an approximate critical temperature between 900 and 940 degrees Cent. above which this oxidation effect may commence. As soon as oxidation begins, the growth of the oxide layer would appear to depend on the result of a race between rate of oxidation and rate of carbon supply by diffusion from the interior. It is for this reason that rapid heating promotes rapid peel growth, as the cementite has not time to dissolve and diffuse at a rate necessary to counteract the penetrating oxidation. The retarding effect of high temperatures will be seen to be due to the more rapid solution and diffusion of the cementite.

The authors have no explanation to offer with regard to the role played by the sulphur content of the material.

New England Foundrymen Hold Outing

The July meeting of the New England Foundrymen's association was held at Brigham's Sunset farm, Paxton, Mass., Wednesday, July 15. Features of the outing were boxing matches, cabaret, a ball game between the foundrymen and supplymen, and a sheep bake. Plants in and about Worcester were open to the visitors.

Change Boston Office

The Boston office of the Penton Publishing Co., Cleveland, publisher of THE FOUNDRY, have been moved from 426 to 1037 old South building.

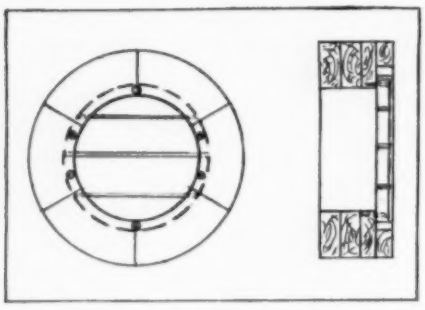


Fig. 1—Construction of Segmental Joints

Patternmaker Should Study Joints

By Walter C. Ewalt

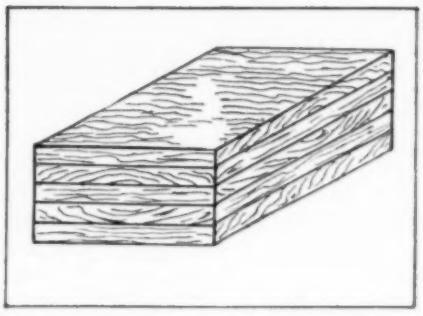
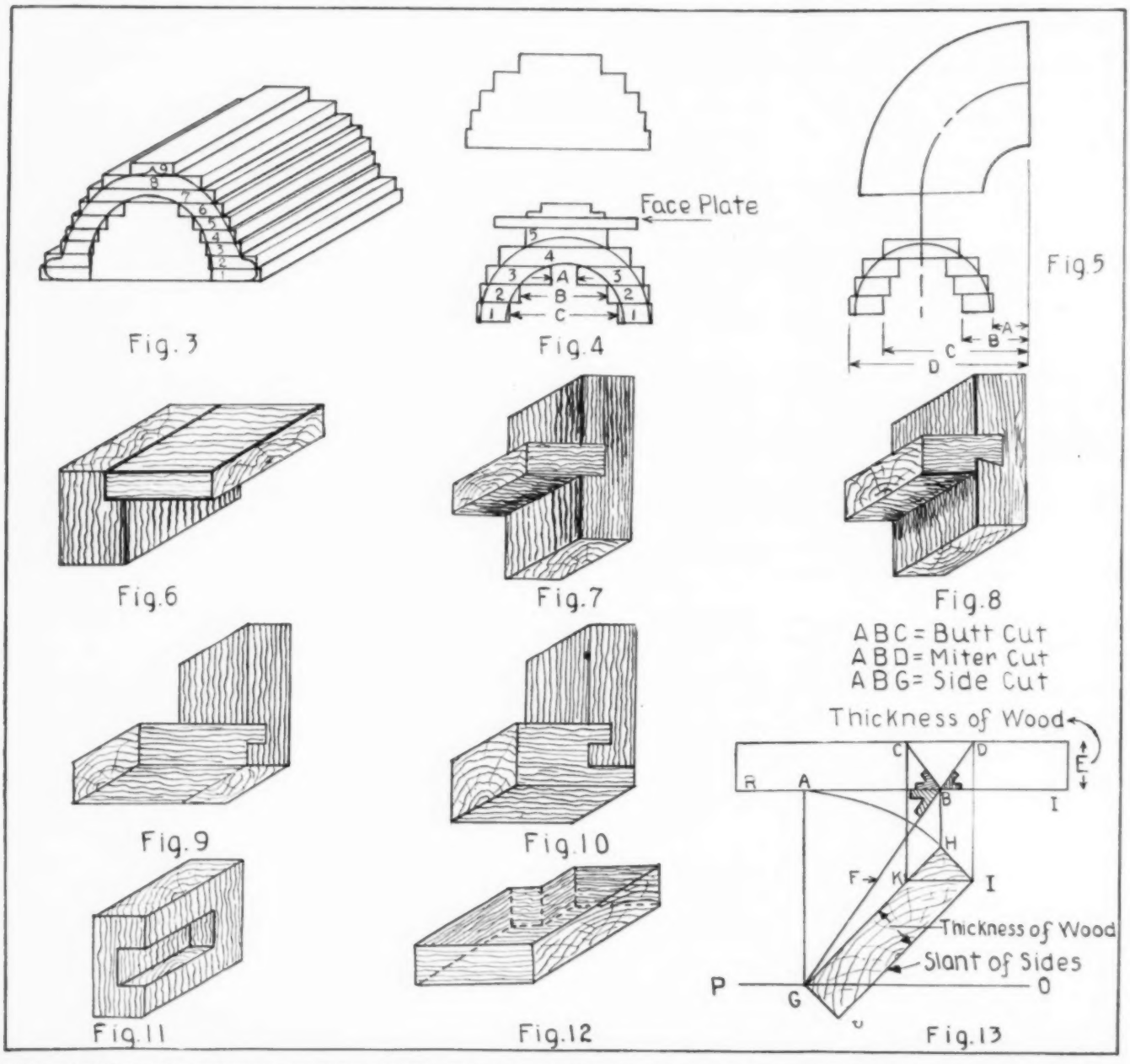


Fig. 2—Constructing Cross Grained Lamination

A NUMBER of joints used by the patternmaker and woodworker were discussed in an article which appeared in the July 1 issue of THE FOUNDRY. The discussion of this feature of patternmaking is enlarged further in the article presented. A construction often is used such as in Fig. 1, which shows a plan and section of segmental joints with a slab back. The segments are built up as in the preceding article. When turned on the lathe, a portion is turned out to fit the end of the boards. The boards are not glued to the segments, but only are screwed on. The joints of the boards are not glued, for if that were done, the swelling or shrink-



FIGS. 3,4 AND 5—CONSTRUCTING STEPPED JOINTS. FIG. 6—A RABBETTED JOINT. FIG. 7—A DADO JOINT. FIG. 8—A DOVETAIL DADO JOINT. FIG. 9—A DADO AND RABBET JOINT. FIG. 10—DADO, RABBET AND LAP JOINT. FIGS. 11 AND 12 COMBINATION OF DIFFERENT KINDS OF JOINTS. FIG. 13—METHOD OF CONSTRUCTION

age would be likely to distort the segmental ring. It is not good practice to allow the boards to extend to the outside diameter of the ring because, as mentioned above, the boards swell leaving an uneven surface to draw out of the sand. The construction shown in Fig. 1 is better than that of making the bottom row of segments extended to the center and especially if the bottom is of thin wood. However, if made with the bottom row of segments extending to the center, a spline should be used to hold the joint. If the bottom is thick enough for three layers of segments, it is good practice to construct the pattern in that manner.

Cross grain laminated joints shown in Fig. 2 are poor practice. If the wood is kept perfectly dry and used thin, for example 1/16 to ⅛-inch thick, the joints may hold, but the surfaces will not remain smooth.

A method of building up a pattern so that the edges of the stave, both inside and outside, guide the work, is shown in Fig. 3. This also applies to rings in circular work. After laying out the inside and outside curves or semicircles the section is divided into parts by horizontal parallel lines which are equal to the thickness of the planed lumber. Lines are drawn square with the horizontal lines at the point where they intersect with the curved lines. The spaces and staves should be marked when they are made so that there will be no trouble when assembling. The distance between the perpendicular lines will be the width of the staves. Ends are made as shown in Fig. 4 on which the pattern is built. When the staves are made, they are placed on the steps, glued together and then worked down, both inside or outside, to the corners. Usually the outside is worked down for the pattern and the inside for the corebox. If the pattern is to be round and both inside and outside are to be turned, the inside is turned first. The pattern is started by screwing course 5, Fig 4 to the face plate of the lathe. Course 4 then is marked with the dividers the diameter of 5, and the side marked is glued to 5, the diameter mark on 4 guiding it to the right position on 5.

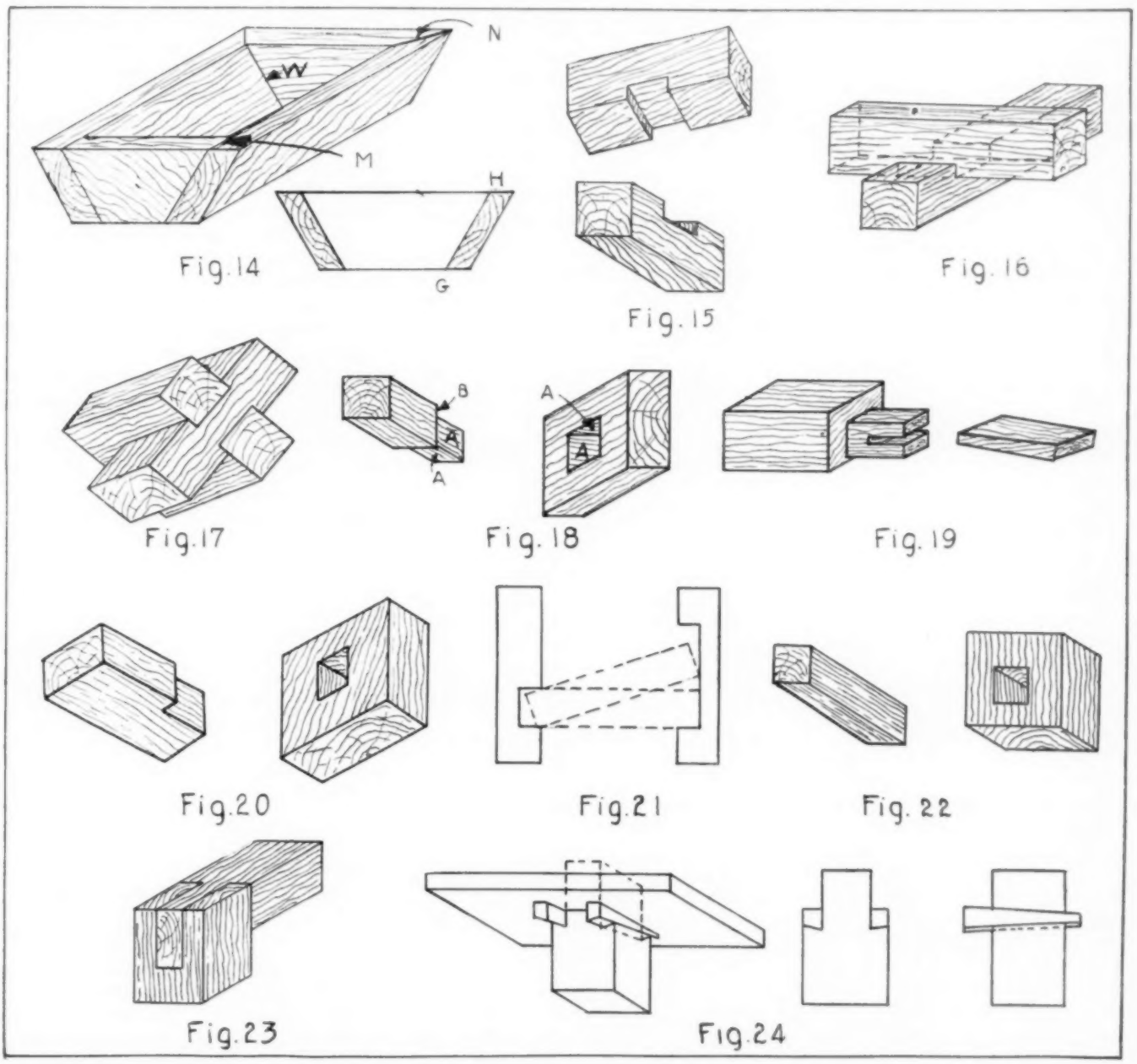


FIG. 14—SHOWING SIDE FACE BEVEL. FIG. 15—A CHECKED JOINT. FIG. 16—A NOTCHED JOINT. FIG. 17—A FORKED JOINT. FIG. 18—MORTISE AND TENON JOINT. FIG. 19—WEDGED TENON. FIG. 20—BARE FACED MORTISE. FIG. 21—CHASE MORTISE JOINT. FIG. 22—HOUSED MORTISE AND TENON. FIG. 23—A SLIP JOINT. FIG. 24—MORTISE AND TENON

Then, as the glue sets, the diameter *A* is marked on 4, the diameter *B* on 3 and diameter *C* on 2. The inside then is finished by turning down to the corners.

The patterns are reversed in the lathe and the outside turned off in the same manner. It will be necessary in this kind of work to saw the segments close to the lines. Curved work like bends are made up in the same manner, except that the radii will all be different. This may be seen in Fig. 5. The radii *A*, *B*, *C* and *D* of the first course only are shown, while the other three courses all have different radii.

A common joint is a rabbetted joint shown in Fig. 6 where one member is cut out slightly leaving a shoulder for the other member to rest upon. This joint may be fastened strongly by glue and by driving nails through both members. The grain of the wood may run either with or across. Two dado joints are shown in Figs. 7 and 8. A dado is a groove across the grain of the wood. The one shown in Fig. 7 is used often. In Fig. 8 the dove tail end of the member is slid in at the edge of the board, this joint being much stronger than the one shown in Fig. 7.

Describes Hopper Joint

Combinations of different kinds of joints are shown in Figs. 9, 10 and 11. The one shown in Fig. 10 is stronger than that illustrated in Fig. 9, since the end grain is covered over with the lap. The groove, Fig. 11, is made so that the edge *A* will not show the dado as it does not go clear across the board. The hopper joints which, for example, are used in tapered flasks, are shown at Fig. 13. In Fig. 14 at *M* is shown the butt joint and at *N* the miter joint. In Fig. 13, *G*, *H*, *I* and *J* represent the end and *E* the thickness of a board used for the sides. The inclination in relation to the base line *PO* is shown at GH. With the dividers with one point at *G* and the other point at *H* an arc is struck to *A* which is square with *G*. Through *A* the line *RT* is drawn parallel with *PO*. Then *HB* is drawn square with *RT*, the bevel *A*, B and *G* being the side face bevel or the same as the line *W* in Fig. 14. The end butt cut is found by drawing a line from *I* to *K* parallel with *RT* and while a line *KC* is drawn at right angles to *IK*. It will be noticed that *E* is the thickness of the board here as well as when inclined. The points *B* and *C* are connected, the bevel *A*, *B* and *C* being the end butt cut. The miter cut is found by erecting a line at right angles to *KI* as at *ID*. The miter cut is then *DBT*, or the butt cut is *CBT* and the miter cut *ABD* according to the way in which the bevel is used. A patternmaker may make these joints much easier on the disk grinder, so only this hopper joint is mentioned.

Splayed work, such as triangular, square, hexagonal, etc. will be explained in a future article.

Where it is necessary to fasten pieces together without weakening them, a joint as shown in Fig. 15 is used and is called a checked joint. It will be noticed that the pieces are only notched in about 1/3 the width or less. This leaves more wood for strength than the half lap but does not bring the faces flush. The notched joint shown in Fig. 16 is similar to the one just mentioned except that one member only is notched out. A forked joint is shown at Fig. 17. This is a strong joint and usually is made with the end of one piece cut out like a fork and the other notched as shown. As this joint may only slip out in one way, it makes a convenient joint in some patterns with interchangeable parts.

Where two members are at right angles with each other, as illustrated in Fig. 18, the joint is called a mortise and tenon. The sides marked *A* are called cheeks and *B* is the shoulder. This joint is of great strength when properly made and may be applied to many patterns. Various forms of this joint are made, the one shown in Fig. 14 being called a wedged tenon. This may be made whether the mortise is through or blind. The through mortise and tenon is one where the tenon extends through the mortised member and the blind is one where the mortise is worked out only partly through the member. Often the sides of the mortise are flared so that the wedge spreads out the tenon and makes a dovetail of the joint. In any case, it prevents the tenon from pulling away from the mortise.

The bare face tenon is shown in Fig. 20. Fig. 21 shows the chase mortise where the mortise is sufficiently long to admit the tenon which is then moved down to its right position and the rest of the mortise filled up. The housed mortise and tenon is shown in Fig. 22. The tenon is the full size of the member. The joint shown in Fig. 22, called a slip joint, is an open end mortise and is used frequently. Various other joints are made using keys, dowels and wedges or by incorporating parts of some other kind of joint such as the rabbet. The form of the tenon and mortise may be made into a double tenon. A mortise and tenon joint, such as shown in Fig. 24 often is used by millwrights.

Pipe Rusts Away

By Robert E. Masters

In an old plant in which the writer worked, an unusual combination was found. Water ran through a flume from an old canal to a turbine water wheel which furnished power to run an old fan which forced air through a pipe underground for over 100 feet to a 36 x 72 inch oblong cupola with continuous tuyeres in which nothing but the highest grade of uniform cold blast charcoal pig iron was melted with anthracite coal. This plant was in operation a long time ago, and I wonder if any foundry now in existence uses a similar layout.

The galvanized iron pipe leading from the fan to the cupola was put down about 2 feet under the ground about the close of the forties and had been in service fully 40 years. It was laid across a strip and back of the foundry to the cupola. We seldom took occasion to go back of the foundry, but one day when the blast was on I happened to be walking along the pipe line and noticed the dry earth dancing up and down and bubbling up in little fountains here and there. Putting my hand near the ground I could feel the little jets of air.

At that time we were filling a large order and could not afford to stop for repairs, so we leveled some sand over the pipe, laid a sheet iron on the sand and covered the sheet iron with scrap and sand. We ran for two months before having an opportunity to make repairs. When we dug down we found that the pipe had been corroded by rust, there being nothing left but a film of rust. We were actually blowing the air through a hole in the ground where the pipe had been.

A. E. Goodhue, vice president of sales of the Chicago Pneumatic Tool Co., New York, returned in July from a trip to Europe.

The Hillside Flour Spar Mines, Chicago, has appointed the Independent Foundry Supply Co., First and Spruce streets, St. Louis, as representative in Missouri, Kansas, Iowa, Nebraska, Oklahoma, and Texas together with the Southern part of Illinois.

Milestones in Foundry Progress

As Recorded in the August Issues of THE FOUNDRY, Thirty, Twenty and Ten Years Ago

1895

WE ARE at present passing through a period of transition in foundry practice; leaving the old time empirical rules of thumb and entering upon methods more in accord with modern exact science.

A. SORGE JR.

* * *

Future historians of industry may consider the period from the early nineties through the World war as that of the greatest development in production methods. Distribution is the major problem today.

* * *

John Gaunt, Gloucester, N. J., advised casting bells in molds resting upon water supported floats. The idea was to avoid disarranging the atoms while the metal was freezing. The jar of passing trains and other traffic was said to result in defects.

* * *

Shimmying atoms might be added as alibi No. 12691 for castings losses?

* * *

The Western Foundrymen's association meeting in Chicago discussed subjects ranging from apprentice training to the purchase of pig iron. Maj. McDowell said that pig iron salesmen were obliged to tell the foundryman what kind of iron he should buy.

* * *

—The ability of a foreman to push men in the foundry is for the greatest part controlled by his employers. A tight purse string, an expectation that something is going to come from nothing but wind, is a poor lubricant.

KRANK'S KORNER.

* * *

Rob Roy, said to have been the gaffer in an old time foundry in Scotland had the quaint habit of calling out to warn his men of the approach of a ladle of hot metal. Being an enthusiastic golfer all of his life, it is but natural that his cry of warning should have been FORE which in the vernacular means to look sharp, to duck, to dodge or sidestep. Thus originated the expression, FOREMAN.

* * *

James Chalmers, the tramp molder, whose intriguing adventures were running serially, chased the superintendent out of the latter's shop with a shovel, because his sand heap had been cut over and tempered to the consistency of thin mud by the night gang, against his urgent protests.

* * *

How like a hen with one chick is a molder with poor sand.

* * *

A committee was formed by the Philadelphia Foundrymen's association to plan the formation of a national foundrymen's organization. Walter Wood was chairman and the members were Thomas Devlin, W. H. Pfahler, Thomas Glover, J. Sellers Bancroft, Francis Shuman and Howard Evans.

Faked Foundry Facts

Putting on the Blast

1905

THE National Transit Pump & Machine Co., Oil City, Pa., had placed in service several inovations considered worthy of description in the August, 1905, issue of THE FOUNDRY. J. E. Fisher was foundry superintendent.

* * *

Ruthless Rhymes

Bill, the apprentice, spit into a sprue.
He wanted to see what the iron would do.
At the funeral the neighbors sighed;
"Bill was a good boy. Too bad he died."

W. S. ZIMMERMAN.

* * *

Into the cupola playful Jack.
Pushed his pardner, Scotty Mack.
The foreman sighed as the bottom dropped.
"These boyish antics must be stopped."

* * *

No. 2 foundry iron was bringing $14 to $14.35, valley and southern was $11, furnace in August, 1925.

* * *

J. S. Robeson, Camden, N. J., had an interesting article on molding sands in which he gave sieve analyses and tensile strength results on numerous samples.

* * *

Arthur Simonson discussed the causes of hot cracks in steel castings, a subject which still is considered open to debate.

1915

LYCOMING FOUNDRY & MACHINE CO., Williamsport, Pa., long noted for its automotive castings was an outstanding figure in the eastern foundry industry. The plant of this company was described in the August, 1915 issue of THE FOUNDRY.

* * *

Cast iron was being discussed as a material for making shrapnel casings. The influence of the war was bringing pressure on the industry.

* * *

Wentworth Institute, Boston, had a training course for foundry workers which was described by E. A. Johnson.

* * *

High tribute to the memory of Thomas D. West was paid in a communication from P. L. Simpson, Chicago.

* * *

No. 2 iron was $13.70, Pittsburgh and only $9.75, Birmingham.

The Shakeout

DAN M. AVEY, Managing Editor
PAT DWYER, Engineering Editor
CHARLES VICKERS, Nonferrous Editor
FRANK G. STEINEBACH, Associate Editor

¶ Buying What You Pay For

IN DAYS of old, when knights were bold and all that sort of thing, even current gold coins were received in trade with some apprehension. The chief warder of the knight's household was obliged to have his own private scales to weigh gold coins taken in payment for goods, services or taxes. Why? Because even those coins bearing the sovereign's likeness might have been scraped or filed or *sweated* to remove some of the precious metal therefrom.

THEN came milled or lettered edges which could not be trimmed without defacing the coin and finally standardization and coinage laws which removed the necessity for a household coin scale as a protection against lack of weight or quality. This development does not go back so far, and yet it serves to measure the growth of standardization, the need for some definite specification for every commodity entering into commerce.

TODAY, much is offered to protect the buyer in getting that for which he pays. In a recent address delivered by Dan Harvey, Westinghouse Electric & Mfg. Co., East Pittsburgh, the purchase of all materials on specification is strongly urged. Mr. Harvey advised members of the American Society for Testing Materials, before whom this address was given to insist that material received is as specified. His remarks may well apply to the small foundry, for whom, no less than the large institution, the standards of quality have been developed. Specifications for practically all raw material used in the foundry are available and these should be made the basis for ordering and securing delivery of all such products.

¶ Prepare for Syracuse

C. E. HOYT, secretary of the American Foundrymen's association recently issued his annual reminder to the members that the date of the convention and exhibition is daily drawing nearer and that they will be well advised to begin shaping a program that will insure their presence in Syracuse, N. Y. between Oct. 5 and 9. From present indications it would appear that the coming meeting will establish new high records in many respects, in attendance, in extent and variety of equipment, in diversity of subjects chosen for presentation in the technical papers and in the facilities provided from attending both the technical sessions and the exhibition. The membership of the association has been increased to a gratifying extent during the past year and that feature automatically insures a greater attendance at the convention. With a record attendance in prospect the manufacturers of material and equipment naturally appreciate the opportunity for display and demonstration and already have engaged a great portion of the available space.

¶ Molding Sand Has Its Inning

WHEN two associated manufacturers of foundry equipment, presented the American Foundrymen's association at its convention in Columbus, O., with $2500 to form the nucleus of a fund for prosecuting sand research they gave increased impetus to a movement long recognized as necessary, but which had languished through lack of appreciation on the part of those in position to lend moral and financial support.

Earnest students of the subject were handicapped in their efforts, by the apathetic attitude of the three classes into which nearly all foundrymen may be divided. The first class is made up of the old time, practical, rule-of-thumb men familiar with the physical characteristics of sand through years of actual contact. By taking a handful of sand, squeezing it, breaking it apart and perhaps rubbing it on the handle of a shovel one of these men could determine fairly accurately the fitness or unfitness of the sand for a given purpose.

THE second class of foundrymen includes those who direct all the operations from the front office and who have neither the time nor the inclination to become familiar with the characteristics of sand. To them sand is sand and represents so many dollars a ton landed in the bins. A few of these men realize the importance of procuring the proper grade, but they are satisfied to leave this point to the discretion of their foundry superintendent. Many insist on buying their sand strictly on a price basis.

Then there is the great third class, willing and anxious enough to learn something about sand, but without the slightest knowledge where or how to go about securing any information on the subject. Already the joint committee on molding sand research has made considerable headway in developing methods and standards of comparison. By the time they have completed their work information on the application of sand in the foundry will be in shape to be assimilated readily by any and all persons who may be interested.

Trade Outlook in the Foundry Industry

WITH foundry operations ranging from 60 to 75 per cent of capacity no real reason exists for pessimism, and in the majority of instances no such feeling is expressed. However, some feel that they are not making money against present competition and are inclined to blame this fact on general industrial and business conditions rather than searching in their own trade practices for the fault. No marked changes are expected during the remainder of the summer either upward or downward. The policy of short time buying continues and is confined to no single line of business. Foundries, themselves are buying fuel and metal only for immediate use.

Basically Sound

With the present rate of consumption, with freight loadings for the first five months ranging from 7 to 12 per cent above the same period last year, tremendous mail order sales and other significant factors taken into account the remainder of the year should continue to show advances in practically all lines. Production of automobiles and trucks for June was only about 2 per cent below the preceding month. The total of all classes of automobiles and trucks made in the United States and Canada during June was 402,696, compared with 426,000 for May. June of last year showed a total of 254,146 and May 321,638 passenger cars and trucks. The total production in the United States and Canada for the first six months of this year was 1,936,700 passenger cars and 236,664 trucks, compared with 1,852,137 passenger automobiles and 202,424 trucks for the same period of 1924. No curtailment of production is in sight during July, although slightly more sales resistance is reported. Automobile foundries in general are active, while certain of the nonferrous shops making brass and aluminum parts for automobiles are busy.

Prices For Raw Materials For Foundry

CORRECTED TO JULY 22

Iron		Scrap	
No. 2 foundry, Valley	$18.50	Heavy melting steel, Valley	$17.00 to 17.50
No. 2 southern, Birmingham	17.50 to 18.00	Heavy melting steel, Pitts.	17.50 to 18.00
No. 2 foundry, Chicago	20.50	Heavy melting steel, Chicago	15.50 to 16.00
No. 2 foundry, Philadelphia	20.76 to 21.26	Stove plate, Chicago	16.00 to 16.50
No. 2 foundry, Buffalo	19.00	No. 1 cast, Chicago	20.00 to 20.50
Basic, Valley	18.00 to 18.50	No. 1 cast, Philadelphia	17.50 to 18.00
Basic, Buffalo	18.50 to 19.00	No. 1 cast, Birmingham	16.00 to 16.50
Malleable, Chicago	20.50	No. 1 cast, Buffalo	16.00 to 16.50
Malleable, Buffalo	19.00	Car wheels, iron, Pittsburgh	17.00 to 17.50
Coke		Car wheels, iron, Chicago	17.25 to 17.75
Connellsville foundry, coke	$3.75 to 4.25	Railroad malleable, Chicago	18.00 to 18.50
Wise County foundry, coke	4.50 to 5.25	Agricultural, mal., Chicago	16.50 to 17.00
		Malleable, Buffalo	17.00 to 18.00

Rail Orders Scarce

One of the factors in the present business situation that is difficult to interpret in the light of general conditions is the slack buying of railway equipment. Orders for railway cars are far below normal, while the purchase of rail steel and other commodities is slow. The effect is plainly evident in the operation of railway specialty shops. The heavy steel foundries are slack due largely to this condition. The department of commerce reports that June bookings of all classes of steel castings were 48.2 per cent of capacity, while railway specialty orders represented only 38.8 per cent of capacity. June, 1924, showed the total bookings of steel castings at about 48.5 per cent of capacity, while railway steel castings stood at 60.1 per cent. Bookings of steel castings for the first six months of 1925 were about 10 per cent below those for the same period last year, considering both railway and general commercial castings.

Malleables Stable

Operations of malleable foundries have remained practically the same for the first five months of the year. The reports of 130 identical plants, according to the department of commerce, have ranged as follows: January, 58.6; February, 53.4; March, 53.6; April, 55.4, and May, 54.3 per cent of capacity. Automobile demand has served to bolster up the sales and to maintain the levels quoted. Railway malleables have not been so active, but this has been offset, in the general tabulation by the tremendous advance in agricultural implement sales, and in a measure by miscellaneous electrical and small parts requirements. Orders received for goods manufactured by the General Electric Co., according to President Swope totaled $150,315,228 for the first six months of the year, compared with $144,707,887 for the like period of 1924. Sales of all classes of goods in agricultural communities have improved. The trade extension bureau of the plumbers association has been stressing the growth in sales of plumbing goods to farmers. This bureau reports that only 16.76 per cent of the farm homes have running water systems, and that during the years of 1925-1926, 20.48 per cent of the farms will buy power plant equipment, will build new homes or barns and are logical prospects for plumbing goods. Buying sentiment among farmers never was better. Sales of automobiles, tractors, trucks, implements and all classes of farm machinery are advancing. June declined slightly in Ohio, according to A. J. Tuscany, secretary-manager, Ohio State Foundrymen's association. The rate for May was 77.8 per cent, while that reported for June was 73 per cent of normal. June, 1924, showed 72 per cent, so that the prevailing conditions may be taken as seasonal rather than due to any general trend.

Nonferrous Operations

Brass foundries, especially those making plumbing goods are busy. New York prices on nonferrous metals, according to the *Daily Metal Trade* of July 22, follow: Casting copper, 13.75c; electrolytic copper, 14.30c; Straits tin, 58.50c; lead, 8.25c; antimony, 16.50c; nickel, 38.00c. Zinc is 7.27½c, E. St. Louis, Ill.

Comings and Goings of Foundrymen

GILBERT R. KITTLE and J. M. Kittle recently have been made president and general manager, and vice president and general superintendent respectively of the Ohio Malleable Iron Co., Columbus, O., subsidiary of the Jeffrey Mfg. Co., that city, builder of industrial and mining equipment. Gilbert R. Kittle began his foundry career with the Buckeye Malleable Iron Co., with which he was connected 13 years. He left his position to become superintendent of the Ohio Malleable Iron Co. about two years before that company was acquired by the Jeffery company. J. M. Kittle, brother of the president, was graduated from Ohio State university, and with the exception of about one year when he was employed with the Pennsylvania railroad, his entire time since leaving college has been spent with the company of which he now is vice president and general superintendent.

Edward B. Connor has become connected with the Mexican Corp., Fresnillo, Zacatacces, Mexico.

Heber G. Stone, export manager of the Chain Belt Co., Milwaukee, has returned from a six months' business tour of South America.

Swayzee Foundry Co., Swayzee, Ind. has appointed J. O. Pettigrew, Harvey, Ill., vice president and general manager.

O. J. Finner has been promoted to foreman in the foundry of S. Flory Mfg. Co., Bangor, Pa. He has been employed by that company for 32 years.

Arthur J. Pence, general sales manager of Moore Bros. Co., Joliet, Ill., manufacturer of stoves, has resigned to head a new company to be known as the Pence Stove Stores, Inc.

Wm. H. Kleppinger, Calumet Foundry & Machine Co., East Chicago, Ind., recently spoke before the chamber of commerce of Highland, Ill., as a representative of the East Chicago organization.

G. K. Viall, formerly associated with the Sivyer Steel Casting Co., and more recently with the Chain Belt Co., Milwaukee, has been promoted to take charge of service in the concrete mixer and paving equipment department of the Chain Belt Co.

James W. Grossman, for the past three years foreman of the iron foundry of the Mackintosh Hemphill Co., Midland, Pa., has accepted a position with the Dennison Alloy & Steel Casting Co., Dennison, O., as general foundry foreman. Mr. Grossman has had a wide experience in foundries in the United States and Canada.

Edmund Jule Rang, student's secretary of the Newcastle association of the Institution of Civil Engineers and immediate past president of the Institution of British Foundrymen, Newcastle junior section, has been given the degree of M. Sc. in civil engineering of Durham university. Mr. Rang won the North East Coast Institution of Engineers and Shipbuilders' scholarship in 1919, and while at Armstrong College gained first-class honors in the examination for B. Sc. He served an apprenticeship in engineering in the shops and drawing office of the Wallsend Slipway Engineering Co., Ltd., Wallsend-on-Tyne.

GILBERT R. KITTLE

Plan Meeting of Ohio Foundrymen

Several changes in the schedule of events at the annual meeting of the Ohio State Foundrymen's association, which will be held at Cedar Point, O., Sept. 3 and 4, recently have been announced. The business session of the convention will be held Thursday afternoon, at which time the business of the convention, including the election of five new directors, will be transacted. The convention dinner will be held Thursday evening, and plans are being made to hold a banquet for the ladies at the same time. Friday will be given over to talks and discussions, on various subjects of importance to the foundry industry. On Friday noon group luncheons will be held, featured by round table discussions on topics of interest, including foundry costs, the electric furnace, insurance, etc. The following committees have been appointed: Reception, Joseph H. Bruce, chairman, Bowler Foundry Co., Cleveland; entertainment, Walter L. Seelbach, chairman, Walworth Run Foundry Co., Cleveland; nominations, B. R. Pearce, chairman, Atlas Foundry Co., Cleveland; and resolutions, George W. Piehl, chairman, Wessling Bros. Foundry Co., Cincinnati.

Will Hold Joint Session in Syracuse

Institute of metals division of American Institute of Mining and Metallurgical Engineers will hold its fall meeting in connection with American Foundrymen's association at Syracuse, N. Y., during the week of Oct. 5. Three joint sessions have been planned, a general session on nonferrous topics, a session on aluminum-alloy topics and a third meeting will be a round table luncheon discussion on brass foundry problems. The tentative schedule of these meetings is as follows:

Monday, October 5, 2 p. m.
General nonferrous topics

"The Advantages of Recuperation in Connection with High Temperature," by Col. H. D. Savage, Combustion Engineering Corp., New York City.

"The Present Status of the Investigation of Fatigue of Nonferrous Metals," by H. F. Moore, University of Illinois, Urbana, Ill.

"Some Refractory Problems in the Nonferrous Electric Furnace Casting Shop," by G. F. Hughes, Bridgeport Brass Co., Bridgeport, Conn.

"Temperature Control of Nonferrous Alloys," by R. L. Binney, Bunting Brass & Bronze Co., Toledo, O.

Tuesday, October 6, 10 a. m.
Aluminum alloys session

"Aluminum Alloys in Air Craft," by S. Daniles, engineering division, air service, U. S. A., McCoog field, Dayton, O.

"Some Notes on the Founding of Light Alloys," by R. de Fleury, Paris, France. Annual exchange paper of the Association Technique de Fonderie de France before the American Foundrymen's association.

"Mechanical Properties of the Aluminum-Copper-Silicon Alloy as Sand-Cast and as Heat-Treated," by Samuel Daniels and D. M. Waner, McCook field, Dayton, O.

"Aluminum Alloy Permanent Mold Castings,"

by J. B. Chaffee Jr., Permold Co., Cleveland

Tuesday, October 6, 12:15 p. m.

A round table discussion will be held with George K. Elliott, Lunkenheimer Co., Cincinnati, as chairman. This session will be devoted to an informal discussion of shop problems and should be of especial interest to shop foremen and superintendents. No special papers will be read.

In addition to the joint session, the nonferrous foundrymen and metallurgists will be interested in the sessions on refractories, sand control and shop management. The exhibit of foundry equipment and supplies held in conjunction with the technical meetings is one of the greatest educational opportunities of the year for those interested in the foundry industries.

Installing New Furnaces

The Wanner Malleable Castings Co., Beloit, Wis., recently contracted for two steel melting furnaces developed in Germany, which are being installed under the supervision of the American Bosshardt Furnace Corp., New York. These furnaces are designed to produce high temperatures, the coal gas producer being built into the furnace and supplying gas directly to the interior of the furnace. The ports bringing the heated air from the checkers are placed close to the gas inlet ports to obtain an intimate mixture, and the ports are designed to keep excessive heat from the roof.

Norwegian Firms Radios Arrester Order

A complete business transaction by radio between a manufacturer in Cleveland, and a purchaser in Norway was concluded last week with the shipment of a dust collector made by the W. W. Sly Mfg. Co. to A. S. Maskinagentur, mine equipment engineer. The dust collector was crated and on its journey of more than 5000 miles within 25 days from the time the inquiry was received. An unusual feature is the fact all details relating to the order were negotiated by six radiograms, involving an expenditure of more than $2000 by the purchaser for equipment for which he had only a catalog description, and the reputation of the maker.

The first radiogram was dated Trondhjem, Norway, June 16, 1925, and was as follows:

W. W. Sly Mfg. Co., Cleveland.

Wire price, delivery time, one dust arrester, 150, *alternative* 300, *cubic meters per minute. State air resistance, clean filter. Maskinagentur.*

The Sly company quoted prices by radiogram June 18.

Four days later the following radiogram was received by the Sly company:

Order one arrester 300 *cubic meter three weeks. Please confirm.*

The same day the following radiogram was sent in return:

Arrester order entered. Furnish us complete instructions.

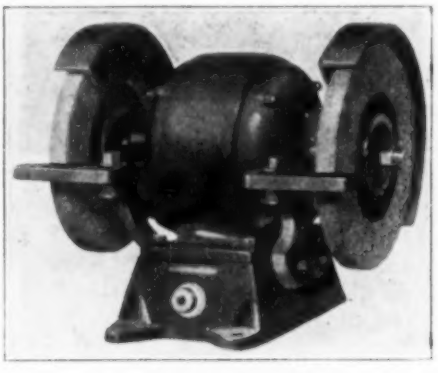
The next day, came from Trondhjem:

Forward Norwegian-American line. Our address Trondhjem.

On July 6 the Cleveland company sent another radiogram asking which bank in New York would make payment, and on July 8 a radiogram was received naming the bank. The radiograms were sent from Norway to New York, and thence by wire to Cleveland. The usual correspondence was carried on by letter confirming such messages.

Builds Electric Grinder

The bench grinder shown in the accompanying illustration is an improved model recently developed by the Azor



THE BENCH GRINDER IS FITTED WITH TWO WHEELS

Motor Co., Cleveland. It is fitted with substantial guards over the wheels, while the work rests are adjustable. The wheels are 8 inches in diameter and ¾-inch face. The motor may be supplied for direct or alternating current. It develops 1/3 horsepower at a speed of 1800 revolutions per minute. The bearings are dust proof. The tool weighs 55 pounds and current for operating may be taken from a light socket. The controlling switch is at the front of the machine on the base.

Sash Weights Poured in Iron Molds

Question: We contemplate increasing our sash weight production to approximately 3 tons per day and are thinking of changing over from sand to chill molds. We are not familiar with this type of equipment and will appreciate any information you may give us on the details of construction and operation.

Answer: Hinged, water jacketed chill molds are employed for the purpose outlined. They are set up in batteries of two lines and from 12 to 18 molds in length. They are erected vertically for pouring in a pit from 12 to 18 inches deep depending on the length of the chills. The object is to have them at a convenient pouring height. A 4-inch water pipe laid on the bottom of the pit connections between the two rows of chills, furnishes the water for keeping the chills cooled. The 1-inch pipe connections between the back halves of the chills not only serve to convey the water but they also brace the chills and hold them in position. A piece of rubber hose conveys the water to the front half of the chill and allows the front half to be swung out of the way to permit removal of the castings. A suitable drain in the bottom of the pit carries the spent water back to the tank or reservoir from which the supply is derived.

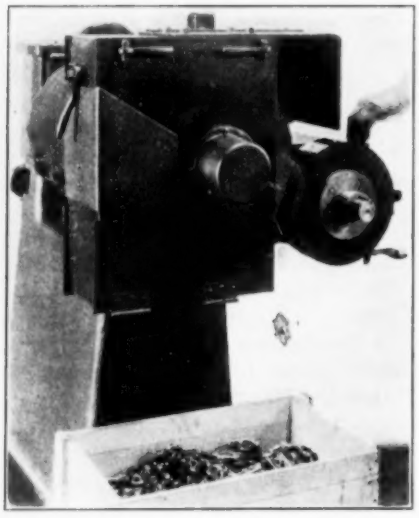
Iron may be poured in these chill molds every 10 minutes throughout the day, if necessary. By the time the last chill in the battery has been poured, the first again is ready. The water prevents them from becoming too hot at any time.

No figures are available on the probable life of these molds. Instances are on record where they have been used continuously for 5 years and apparently still are in the best of condition. The halves of the chill are held together by an eccentric clamp which allows the chill to expand as it becomes heated but still holds the halves close enough to prevent the iron from leaking through.

Expand Research Plans

An extension of the research program has been arranged by the council of the British Cast Iron Research association. The influence of silicon, manganese and phosphorus on the formation of graphite in cast iron will be investigated by M. L. Becker, M. Sc. at the University of Manchester under the supervision of Prof. F. C. Thompson. Dr. W. Rosenhain, F. R. S., will investigate the alloy systems of iron-silicon, iron-manganese and iron-phosphorus in the presence of carbon over the range usually associated with cast iron. It is expected that the information from these fundamental investigations will be of great value in connection with other investigations in hand.

The director and consultant of the association are now visiting Germany.



THE CASTINGS ARE PLACED IN THE RECEPTACLES BY HAND

Speed Transformer Made in Several Sizes

The Hill Clutch Machine & Foundry Co., Cleveland, has developed a spur gear speed transformer for general industrial work where speed transformer units are operated under continuous or heavy service conditions. The speed transformer consists of a nest of plain spur gears revolving in oil, changing the revolutions per minute of the input shaft to some desired revolutions per minute of output shaft. The power transmitted is the same in both shafts. The gears have 20 degree involute form cut teeth. The central housing in the main frame is of importance. With this construction the gear transformer has both high and low speed shafts supported in double bronze bearings. Provision also is made for ordinary thrust conditions. The cap and both ends may be removed quickly. The entire unit is enclosed and is dust proof and leak proof. Both high and low speed shafts are in identical axial alignment. The action is positive and both shafts revolve in the same direction. The speed transformer is made in seven sizes. Each size has a number which bears a fixed relation to the diameter of the low speed shaft. The number also indicates the horsepower the low speed is capable of safely transmitting at 100 revolutions per minute.

Removes Gate Burs

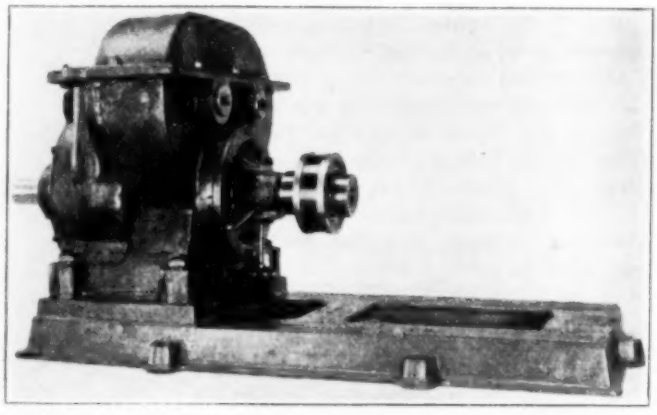
The Ransom Mfg. Co., Oshkosh, Wis., has placed a grinding machine on the market designed to remove gate burs on small castings. As shown in the accompanying illustration the castings are placed in the receptacles in the revolving holder by hand. They then pass the wheel and drop into a box on the floor below.

The feed is taken from the gear box on the other end of the spindle. The feed shaft makes 1½, 2, 2½ revolutions per minute, these changes being made by shifting gears in the feed box with a lever. A 5 horsepower motor is used.

The guard is fixed on a hinged lid so that it may be removed easily to change the wheels. A removable piece at the back of the guard permits access for truing. The wheel runs in the opposite direction than is customary, the direction of rotation in front being up.

Truck May Be Placed on Floor or Track

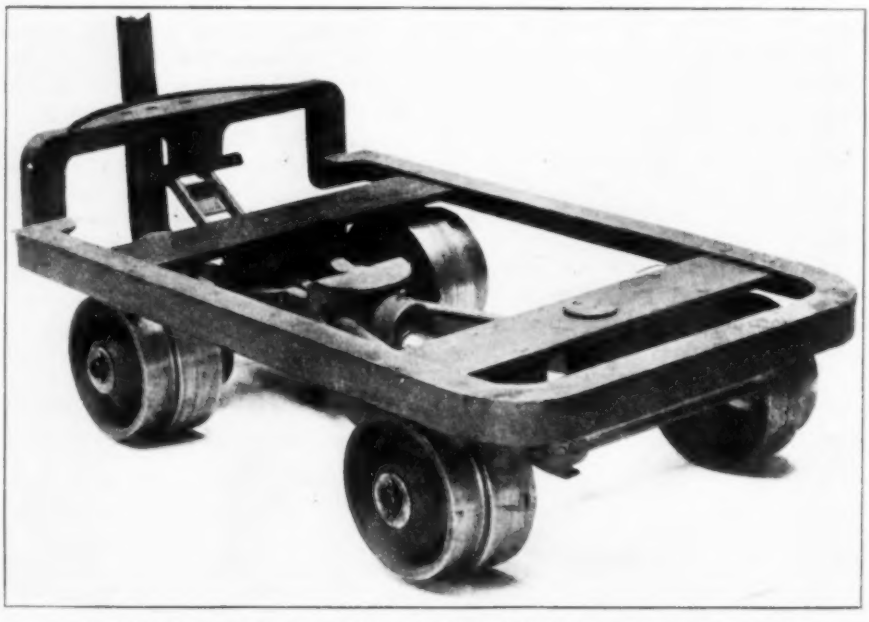
The Plimpton Lift Truck Corp., Stamford, Conn., has made several improvements on its combination floor and rail lift truck, designed particularly for handling pig iron and scrap in foundries where it is desirable to roll on flooring independent of tracks while inside of the building, but on a track for trips outside. The truck operates on a 24-inch narrow gage track.



THE TRANSFORMER IS BUILT FOR HEAVY SERVICE

The truck is equipped with a radiused front bracket plate against which the handle is thrust, enabling the operator to push the truck as well as to pull it. The lifting is accomplished by the downward stroke of the handle. The handle is retained automatically in a vertical position when not in use so that it cannot drop down between floors on an elevator or elsewhere.

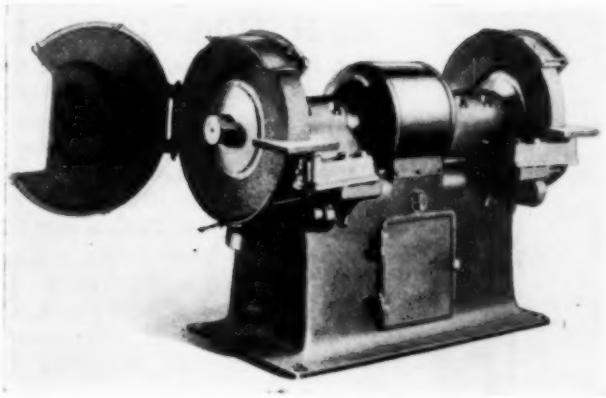
The wheels have two surfaces, as may be noted in the accompanying illustration. The outer or small surface runs on the rail and the inner or large surface takes the weight of the truck when necessary to use it on the floor.



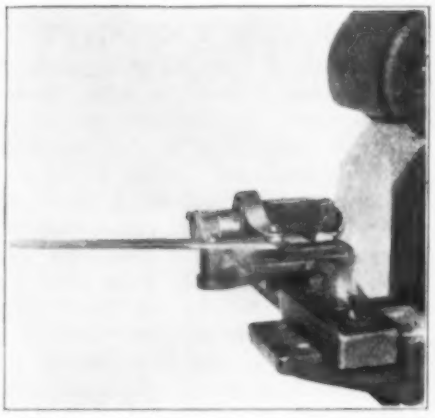
A RADIUSED FRONT BRACKET PLATE ALLOWS THE TRUCK TO BE PUSHED OR PULLED

Foundry Grinder Handles Heavy Work

The Cleveland Stone Co., Cleveland, recently has introduced a new grinding machine for heavy duty foundry work. Among the features claimed for this machine are its ready accessibility and the fact that the drive shaft and motor housings practically



SIMPLE CONSTRUCTION IS CLAIMED FOR THE GRINDER



CUTTER IS CONTROLLED BY LEVER ACTION

Jolt Squeezer Machine Is Portable

The Adams Co., Dubuque, Ia., has introduced a new jolt squeezer of the portable type for light and medium class work. Simplicity in design is claimed through the use of a small number of moving parts. Controls are located conveniently, thus eliminating unnecessary moves on the part of the molder. The cylinder arms are of one piece construction. The squeeze piston is 10 inches in diameter with closely fitting rings to prevent leakage. The jolt piston is 4 inches in diameter fitted with two piston rings and having a long smooth bearing. The table has a working surface of 16 x 20 inches, and is rounded on the front edge to facilitate rolling over the flask. Stop rods prevent the piston from blowing out of the cylinder and maintain alignment of the table. Adjustment of the head is had by brass nuts. A steel shield protects the pistons from sand and dust, while a blow cock is furnished to keep the table and patterns free from sand.

The counterbalance springs are adjustable and may be removed easily. On the portable type, large wheels facilitate movement about the shop. The hubs are faced and bear on steel washers, while bronze bushings are used in the wheels to lower the friction. This machine may be used as a plain squeezer, as a combination jolt squeezer, or as a plain jolt machine without the necessity of adjustments.

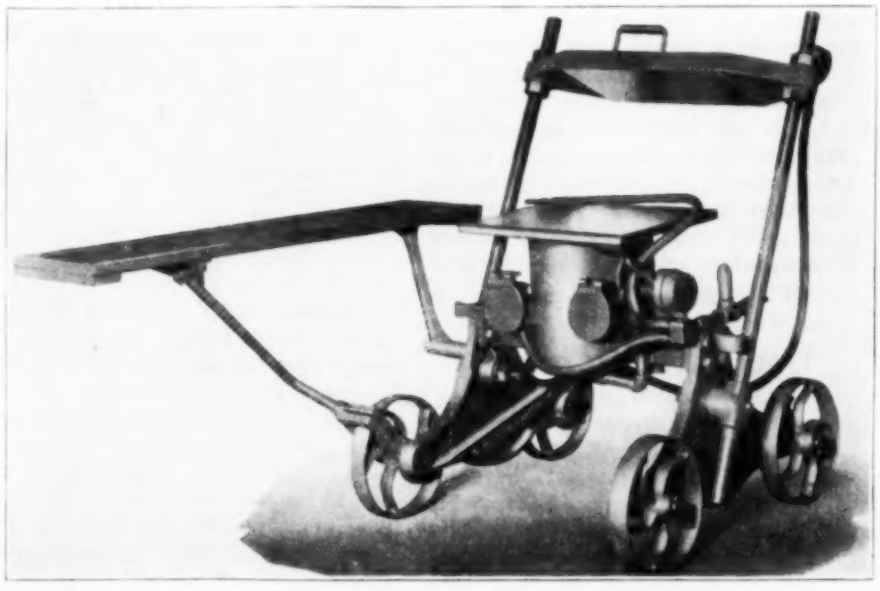
THE SET IS MADE OF HIGH QUALITY STEEL

Introduces Rivet Set

The Ingersoll-Rand Co., New York, recently has introduced a rivet set for pneumatic hammers. The set is made of high quality steel which, it is said, will stand much heat from hot rivets without the temper becoming drawn. The set is forged and then heat treated by a new process which renders it wear and heat resistant.

Builds Trueing Device

The maximum cutting efficiency of large abrasive wheels cannot be maintained without occasional trueing. The Ransom Mfg. Co., Oshkosh, Wis., has introduced an attachment for trueing large abrasive wheels, which clamps to the rest of the machine. The cutters, running on ball bearings, are controlled by the lever shown in the accompanying illustration, and the travel is on a planed way across the face of the wheel. The cutters may be adjusted to the wheel by a hand wheel. The device may be used on wheels up to 4 inches in width.



THE MOLDING MACHINE HANDLES LIGHT AND MEDIUM WORK

The Enterprise Sand Co., Pittsburgh, has completed its new sand mixing plant at Conneaut, O., and is now producing natural and mixed sands.

Coloring Plowshares

Question: Into what solution are plowshares dipped to give them a blue color? Can spiegeleisen be used to any advantage in the cupola for chilling castings?

Answer: To obtain a blue color on plow shares, first polish and thoroughly cleanse with lime the parts that are to be blued. Then brush over with the following mixture: Butter of antimony, 8 parts; fuming nitric acid, 8 parts; and hydrochloric acid, 16 parts. Add the hydrochloric acid to the mixture slowly, drop by drop, to avoid heating the solution. Apply the mixture to the cast iron or steel parts with a rag and rub thoroughly with green, young, oak wood until the desired blue is produced.

Another method to use in obtaining a durable blue color on cast iron and steel is as follows: Dip the article in a ½ per cent solution of potassium ferricyanide, red prussiate of potash, mixed with an equal volume of ½ per cent solution of ferric chloride.

Spiegeleisen or spiegel, referred to occasionally as specular pig iron, runs from 10.0 to 30.0 per cent manganese and may be used to advantage in the cupola furnace to raise the manganese content in the mix which makes the iron more susceptible to surface chills. Care will have to be exercised in the amount used, due to the high manganese content.

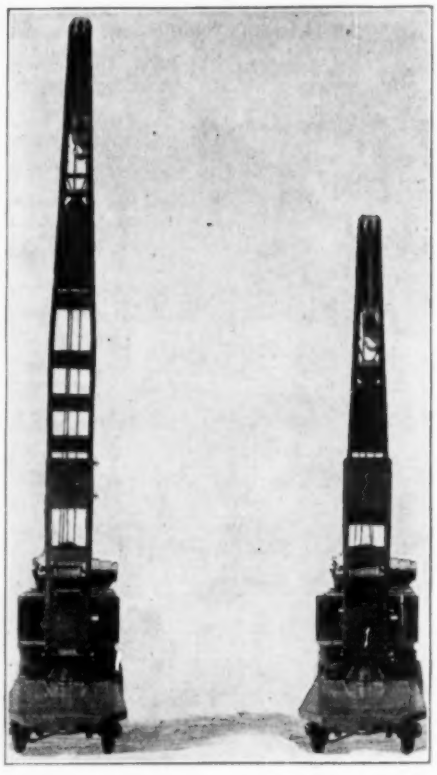
Give Supply Statistics

Foundry supplies are manufactured to some extent as secondary products by plants engaged primarily in other industries. The value of such commodities thus made outside the industry proper in 1921 according to the department of commerce was $541,145, an amount equal to 10.9 per cent of the total value of products reported for the industry as classified.

Of the 64 plants engaged in the manufacture of foundry supplies and reporting to the department of commerce for 1923, 19 were located in Ohio, 17 in Pennsylvania, 10 in Illinois, 5 in New York, and the remaining 13 in Alabama, Connecticut, Indiana, Massachusetts, Michigan, Missouri, New Jersey, and Virginia.

Electric Truck Crane Has Extension Boom

Many users have found that an especially long boom on a crane is a hindrance rather than a help at times, while with a short one there are frequent calls for a lift beyond the boom range. To meet this situation,



THE BOOM HAS FOUR SETTINGS BETWEEN 12 AND 17 FEET

a storage battery truck with telescoping boom with 4 settings between 12 and 17 feet has been developed by the Elwell-Parker Electric Co., Cleveland. The boom is all steel and raised or lowered by a special set of cables operated from an electric motor driven hoist unit with two grooved drums. The second drum carries the separate, ⅜-inch, plow-steel cable to a two-part, line hook block sheave on the boom tip. The heavy boom side channels are latticed and gusseted with a continuous ¼-inch steel plate extending above from the hoist cable sheave to the boom elevating sheave. A feature of this boom is that the distance from top of boom to the hook is but 23 inches. The advantages of this design may be noted when handling in low head room or reaching over a gondola car or motor truck. The battery compartment carrying the hoist unit counterbalances the boom with load on a steel crane column supported on ball and roller bearings.

Use Large Tonnage

Careful estimates of the value of automotive steel consumption for 1923 placed this figure at $300,038,000, which was 16 per cent of the total value of all steel produced last year. The influence of alloy steels and of the higher grade steel products used by the automotive industry is indicated in value figures.

E. R. Hibbs Is Dead

Ellis Reeves Hibbs, the U. W. Paxson Co., Philadelphia, died July 7, aged 56. Mr. Hibbs was born in Phoenixville, Pa., while his home at the time of his death was at Palmyra, N. J. Mr. Hibbs had been associated with the Paxson company for the past 24 years being manager of the sand sales department and also in charge of the production of sand at the banks of the company through Pennsylvania and New Jersey. Mr. Hibbs, who was a son-in-law of Alfred Platt, one of the founders of the Paxson company, was well known in the foundry industry through the Eastern section.

Consolidate Interests

Dempsey Furnace Co., Jersey City, N. J., has been consolidated with W. N. Best Corp., New York. The combined furnace business of the two companies will be operated as Dempsey Furnace division of W. N. Best Corp., under the direction of H. B. Dempsey.

Obituary

George A. Wood, president of T. B. Wood Sons Co., Chambersburg, Pa., died suddenly at his home June 17, aged 79 years, 8 months. Mr. Wood was a son of the late T. B. Wood, and was born Oct. 9, 1845, at his grandfather's farm near New Kingston. At the age of 16 he left Chambersburg academy to become associated with his father in the foundry and machine shop which the latter had established some years earlier. The period from that time until his death gave Mr. Wood an uninterrupted active business connection with that company of more than 63 years. For the past 20 years he was president of the First National bank of Chambersburg. He is survived by his wife, three sons, a daughter and two brothers.

Nelson S. Hopkins, president of the Cream City Foundry Co., Milwaukee, and director of purchases of the Cutler-Hammer Mfg. Co., died of heart disease while golfing at the Oconomowoc Country club, July 4. He was 53 years old and a native of Milwaukee. Mr. Hopkins was graduated from the University of Wisconsin, college of law, but preferred to follow a mechanical career and joined the Cutler-Hammer company in 1902 as an electrical tester, later becoming purchasing agent and a member of the board of directors.

Foreign Interest Develops

European Foundries Give Attention to American Equipment—Michigan Malleable Foundry Starts Comprehensive Extensions Involving Electric Malleable Melting

DURING the summer months, inquiry for American foundry equipment from abroad has quickened. Interest is shown particularly in electric furnaces and powdered coal fired melting and annealing furnaces. A large order for eight or nine melting furnaces and about 20 annealing ovens originating in England is said to have been closed, the business going to an American builder. French malleable makers also have turned their attention to powdered fuel. One of the largest orders recently closed by electric furnace builders was that placed by the Saginaw Malleable Iron Co., division of the General Motors Corp., Saginaw, Mich., for a battery of electric furnaces with a capacity of 24 tons per hour of malleable iron. The contract was placed with the Pittsburgh Electric Furnace Corp. A continuous type molding, pouring and shakeout installation will be constructed and a continuous, tunnel kiln annealing oven will be built. The latter has been awarded to American Dressler Tunnel Kilns, Inc., Cleveland. Austin Co., Cleveland, is handling the engineering on the Saginaw project.

Summer Period Affects New Inquiries

PROSPECTIVE demand for foundry equipment looms heavy as castings production continues unabated through the summer season in the New England section. Inquiry is most encouraging but recent sales have been comparatively few. The General Electric Co. bought a 10-ton crane for its Lynn, Mass., plant. Jenkins Bros. at Bridgeport, Conn., bought two sand conditioning machines from the Royer Foundry & Machine Co., Wilkes Barre, Pa. Scattered Massachusetts foundries bought a total of from 10 to 12 molding machines. Metal flask demand is reported more urgent than any time in 1924. The American Steel & Wire Co., Worcester, Mass. and the Onondaga Steel Co., Syracuse, N. Y. have purchased cupolas from the Whiting Corp., Harvey, Ill. New London Ship & Engine Co., Groton, Conn. has purchased ventilating equipment from the Pangborn Corp., Hagerstown, Md. A sand blast room will be installed at the Glenwood Range Co., Taunton, Mass. by the W. W. Sly Mfg. Co., Cleveland. The latter firm also has sold tumbling mill equipment to the Southside Malleable Castings Co., Woonsocket, R. I.

Pittsburgh Encounters Halt

SOMETHING in the way of a halt has come to certain negotiations for foundry equipment which have been under way in the Pittsburgh district. This interrupted buying is attributed to the usual mid-summer slump on account of the vacation period, and inventory taking. Buying is expected to resume in August or September and in the meantime piecemeal orders are being taken for equipment which has to be bought along with small supplies. Demand for smaller equipment such as riddles, shovels, wheelbarrows, flasks, etc., keeps up remarkably well in view of the limited rate at which general jobbing foundries are running. Action on numerous inquiries for molding machines is held up, but several are expected to be closed before another two weeks. The Flockhart Foundry Co., Newark, N. J., bought one molding machine for quick shipment and within three days after the order was received it was shipped by the Herman Pneumatic Machine Co., Zelienople, Pa.

A Columbus, O. foundry will purchase two or three molding machines and several other foundry operators are inquiring by mail, telephone and telegraph for one or two units apiece. The Iron City Sanitary Mfg. Co., Zelienople, Pa., is expected to buy molding machines and some additional equipment of various sorts. The Westinghouse Electric & Mfg. Co. has contracted with the American Bridge Co. for 800 tons of steel for a brass foundry at Linhart, Pa., and is inquiring for a 5-ton crane. It likewise will purchase various other kinds of equipment, but the inquiry is not yet out. For its East Pittsburgh plant it wants a number of machine tools, grinders, etc., dealers being in receipt of its third quarter list and bids now are being tabulated. The J. C. Williamson Foundry Co., Bellwood, Pa., is understood to be inquiring for equipment to replace that recently lost in a fire. The Elliott Co., which has contracted for 700 tons of steel with the Fort Pitt Bridge Works, Pittsburgh, for an addition to its foundry at Jeannette, Pa., is inquiring for a crane and probably will purchase other types of equipment. The five cranes on the list of the Youngstown Foundry & Machine Co., Youngstown, O., still are pending, as are the three on the list of the Bessemer Gas Engine Co., Grove City, Pa., to be ordered by Frank Chase, Chicago. The Electric Steel Co., Portland, Oreg., has purchased a 7½-ton geared ladle and the Sterling Steel Foundry Co., Braddock, Pa., and Pettibone-Mulliken Co., Chicago, also have purchased heavy ladles from the Whiting Corp., Harvey, Ill. The Tennessee Stove Works, Chattanooga, Tenn. has purchased tumbling mill equipment from the W. W. Sly Mfg. Co., Cleveland. Ajax Iron Works, Corry, Pa., has contracted for sand blast equipment with the Pangborn Corp., Hagerstown, Md. Crucible Steel Castings Co., Lansdowne, Pa., has purchased a dust arrester from the latter interest.

Cleveland Is Quiet

SALES of foundry equipment in the Cleveland district are slow, being confined mainly to small lots or to repair parts. During the past two weeks vibrators have constituted an exception and inquiries also are extant for molding and sand conditioning equipment for automotive foundries. Pacific Stove & Foundry Co., Seattle, Wash. has purchased sand blast equipment from the Pangborn Corp., Hagerstown, Md. Youngstown Foundry & Machine Co., Youngstown, O. will build

a foundry and will require a number of cranes. Des Plaines Foundry Co., Des Plaines, Ill., and American Brake Shoe & Foundry Co., Baltimore, have purchased tumbling mill equipment from W. W. Sly Mfg. Co., Cleveland.

Western Outlook Brighter

INQUIRY for foundry equipment in the Chicago district took a decided spurt beginning with the third week in July and equipment makers were hoping to close a good portion of this. The Standard Foundry Co., Racine, Wis., is placing equipment for a new coreroom. The National Engineering Co., Chicago, has sold sand mixers to the Denver Rock Drill Co., Denver, Colo.; West Michigan Steel Castings Co., Muskegon, Mich.; Swayne-Robinson Co., Richmond, Ind., and Century Electric Co., St. Louis. The Standard Foundry Co., Racine, Wis., has awarded the contract for a core room building to the Nelson Construction Co., Racine. Contracts for equipment will be let in a few days, and a 5-ton crane may be placed shortly. This is the start of a general rebuilding program. A. A. Wickland, Mallers building, Chicago, is engineer. Remy Electric division, General Motors Corp., Anderson, Ind., Union Steam Pump Co., Battle Creek, Mich., and Keyless Lock Co., Indianapolis, have purchased dust arrester and sand blast equipment from the Pangborn Corp., Hagerstown, while the Stromberg Motor Devices Co., Chicago has contracted for a sand blast installation from the same maker. Diversey Foundry, Geneva, Ill., and More-Jones Brass & Metal Co., St. Louis, have purchased sand blast barrels from the W. W. Sly Mfg. Co., Cleveland. The Nugent Steel Castings Co., Chicago, has purchased a 5-ton crane from the Whiting Corp., Harvey, Ill The latter firm also has sold cupolas to the Piston Ring Co., Muskegon, Mich., and Mason, Davis Co., Chicago.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

An iron foundry is said to be in the process of establishment at Mukden, China.

Superior Steel Castings Co., Benton Harbor, Mich., has purchased a 30-acre site where it contemplates constructing a plant.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has started construction of a brass foundry at Linhart, Pa.

D. A. Ebinger Sanitary Mfg. Co., Columbus, O., has let contract for a factory addition, two stories, 50 x 219 feet.

International Heater Co., Utica, N. Y. has bought site and will erect plant 75 x 185 feet for manufacture of furnace, first unit in much larger plant.

Beloit Foundry Co., Beloit, Wis., has awarded contracts for reconstructing 84 x 200-foot plant recently damaged by fire. (Noted July 15.)

William Cramp & Sons Ship & Engine Building Co., Philadelphia plant at Richmond and Norris streets, was damaged by fire recently.

Bessemer Gas Engine Co., Grove City, Pa., is building additional shops to enlarge its production. Buildings will be of steel. (Noted June 1.)

Koehring Corp., Milwaukee, builder of concrete mixers, etc., has awarded contracts for an extension to its core room. Herbst & Koenzli, 130 Grand avenue, are architects.

Benson Hardware Co., Andalusia, Ala., O. L. Benson general manager, has bought the Morris & Farmer foundry, Samson, Ala., and will continue the business.

The site of the old Livermore Iron & Foundry Co., Adams avenue and Lauderdale street, Memphis, Tenn., is to be occupied by a filling station.

Excell Foundry & Machine Corp., New Haven, Conn., has been incorporated with $50,000 capital by Oscar Fritzall, S. T. Fritzall, Carl A. Mears and C. A. J. Poirot.

Star Sand Blast Cleaning Co., New York, has been incorporated with $15,000 capital to conduct a foundry and cleaning works by A. J. Rosenthal, R. H. Slavin and S. Hutkoff. C. T. Insler, 1540 Broadway, is attorney.

Ground has been broken and construction started on the new plant for the Eagle Foundry Co., Third street, Sylacauga, Fla. Iron pipe manufacture will be one of the first products added.

Repair shops for the Union Tank Car Co., Whiting Ind., are being constructed and include a foundry, machine shop, power plant, wheel shop and other departments.

Muskegon Aluminum Foundry Co., Muskegon, Mich., has nearly completed its new plant 80 x 140 feet, one story, which will give it much larger production.

Draper Corp., Hopedale, Mass., is taking bids on a 2-story plant 100 x 200 feet at Beebe River, N. J., for production of textile machinery.

Perfection Appliance Co., Detroit, manufacturer of iron and nonferrous castings, plans a new plant at Tecumseh, Mich., and may remove its entire production there.

Donald D. Staab, Edwardsville, Ill., has bought a building at Troy and will operate a brass foundry for the production of plumbing supplies.

Work will be started shortly by Alberti & Sons, 2016 South Eleventh street, Philadelphia. The company operates a woodworking and mill work plant.

Lakeside Malleable Casting Co., Twenty-third and Clark street, Racine, Wis., will take bids soon for constructing 1-story, 85 x 300-foot pattern shop and shipping room. H. M. Olborn is secretary.

Nonferrous metals of all kinds will be cast by the newly organized Ajax Foundry Co., South Milwaukee, Wis., formed with $10,000 capital by LeRoy Christensen, John M. Donahue and Cyrus M. Thieme.

M. & H. Valve & Fitting Co., Anniston, Ala., will build a foundry 100 x 500 feet and a pattern shop 30 x 75 feet. J. E. Sirrine & Co., 309 South Main street, Greenville, S. C., is engineer. (Noted June 15.)

The Van Chong Co., shipbuilders, Shanghai, China, recently erected a steel foundry at 862 East Yuhang road. The company also operates an iron and brass foundry at 67 Tungchow road.

Busch-Sulzer Bros. Diesel Engine Co., 3300 South Second street, St. Louis, has let contract to Fruin Colnon Contracting Co., Merchants Laclede building, for additions and alterations to a 1-story foundry building 28 x 46 feet. H. J. Knight & Co., Wainwright building, are archtiects.

H. B. Sherman Mfg. Co., Barney street, Battle Creek, Mich., is taking bids on brass foundry and finishing shop. L. J. Sarvis, 65 East Main street, is architect. (Noted June 15.)

The Grabler Co., 10 Beech street, New York City, manufacturers of plumbers' supplies, etc., has purchased a 7-story industrial building at 38-44 Laight street, and plans to occupy it shortly for a new works.

Extensive machine shops and foundries of the Indiana state reformatory at Pendleton, Ind., were damaged by fire June 30 with heavy loss. The buildings will be reconstructed and the damaged machinery and equipment replaced.

National Cast Iron Pipe Co., Birmingham, Ala., has purchased from the Kenwood manufacturing district a tract of 50,800 square feet at Forty-eighth place and Whipple street, Chicago, where it contemplates constructing a northern office, warehouse and shops building.

S. M. Howes Co., 508 Medford street, Charleston, manufacturer of stoves, is having plans made for a 3-story factory 60 x 100 feet. Fay, Spofford & Thorndike, 200 Devonshire street, Boston, are architects. (Noted May 15.)

Marine City Motor Castings Co., Marine City, Mich., has been incorporated with $10,000 capital to manufacture motor castings and automobile accessories by Lloyd Smith, Calvin A. Keim and Edward J. Kleiman, 545 South Elizabeth street.

R. D. Wood & Co., 400 Chestnut street, Philadelphia, are negotiating for Biles Island, opposite Trenton, N. J., as a site where all its manufacturing activities may be concentrated, supplanting its foundries at Camden and Florence, N. J.

Hoosick Foundries, Inc., has purchased the malleable and grey iron foundries and machine shops of the Walter A. Wood Mowing and Reaping Co., Hoosick Falls, N. Y., and will operate them with modern machinery. The Hoosick company is an outgrowth of the Hoosick Malleable Iron Works, established in 1820 by Isaac G. Johnson.

If You Will Smoke Nickel Stogies DON'T BUY SILK SHIRTS

P. T. Barnum Says!

THEY fancy they are so wonderfully economical in saving a half-penny where they ought to spend two pence, that they think they can afford to squander in other directions.

BACK in the days when our sage friend Phineas T. Barnum was writing the words of wisdom at the right, a proverb of the day said something about saving at the spigot and wasting at the bung. This, translated into terms understood by the modern generation would be, there is no use tilting the filling station hose unless you cut down the carburetor. If any reader of this page happens to be numbered among the 16 individuals in the country who don't drive a car, full explanation will be sent for a self-addressed stamped envelope mailed to the writer with the question plainly stated.

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I KNOW of two individuals in the castings manufacturing business who apparently never heard this fundamental principle stated. The first was a maker of oil-field machinery who gave an order to an advertising counsellor for a catalog of his equipment. He dwelt long and loud upon the necessity for economy. To have heard him talk, you might have thought he was swearing off his taxes. He insisted that several items be omitted from the catalog to reduce the cost. He demanded that the smallest type and only a few drawings be used. These cost less than action photographs, for the line etchings would be less expensive than halftone cuts. All this was over the strenuous protests of the advertising man he had engaged to do the work. After the cost was shaved to the last penny and that copper was squeezed until the likeness of Lincoln was faintly seen under the words One Cent, he asked to have the printing done in two colors, practically doubling the cost.

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THE second foundryman who overlooked the principle, had a different hunch. Business was dull, so he released his lone salesman, bought himself one of those leather cases with a handle that used to be called a brief case, but now known familiarly as a quart-folio. Armed with this evidence that he was a member of the selling fraternity, he sallied forth to get orders, *at cut prices*. He is now in the grocery business.

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WHAT is the use of spending *any* money on catalogs or other printed sales matter unless the result is sufficiently attractive to arouse and hold the prospective buyers' interest. I have before me 12 beautiful catalogs from Sweden. These are issued by the firm known as Husqvarna Vapenfrabriks Aktiebolag. They are in Swedish, English and French. The printing, illustrating and arrangement are equal to any catalogs I have seen, not excepting the so-called *brochures* put forth by the manufacturers of multiple cylinder automobiles. Brochure? Surely, brochure is to a catalog as lingerie is to underwear. But the subject matter of these catalogs is not automobiles, lingerie or grand pianos. They are designed to sell the products of this progressive Swedish foundry which include all classes of household hardware, such as food grinders, ice cream freezers, coffee mills, cherry stoners, slicing machines, all classes of gas, coal and oil stoves, irons, scales, radiators, cast sanitary ware, cast window frames and sashes, cellar doors, ventilators, cobblers' lasts as well as sewing machines, bicycles and firearms. It is well to note that this foundry originally was established in 1689 and was operated on rifle barrels for the Swedish government until 1757 when diversified manufacture was undertaken. Its very age is a guarantee of the success of its sales judgment and the catalogs are a credit to its ability to meet the modern demand. Incidentally its prices for the various articles listed are stated plainly and the company maintains sales representation in 29 different foreign countries.

Phineas, Jr